SCIENCE ABSTRACTS

SECTION A

PHYSICS.

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A star (*) indicates that the Abstract deals with Apparatus and Instruments.

JANUARY, 1937.

GENERAL PHYSICS.

ADSORPTION.

1. Negative Adsorption of Debye-Hückel Electrolytes. K. Ariyama. *Chem. Soc. Japan, Bull.* 11. *pp.* 687–691, *Oct.*, 1936. *In English.*—The author derives a formula for the negative adsorption by a calculation much simpler than given by Wagner, and, later, by Onsager and Samara. No new fundamental assumptions are made. After dealing with the specially simple case of a very dilute binary solution of univalent ions, the effect of concentration is considered, and finally the theory is extended to a number of ions homogeneously distributed in the solution. P. H. B.

2. Electrostatic and van der Waals Adsorption of Iodine on Fluoride Layers. J. F. H. Custers and J. H. de Boer. *Physica*, 3. *pp.* 1021–1034, *Nov.*, 1936. *In German.*—The strong absorption of light by I_2 adsorbed on CaF_2 only occurs until a degree of occupation of about 0·5 % is reached, after which van der Waals adsorption begins and the absorption intensity falls to the normal value for free I_2 molecules, although the maxima are still displaced. As the degree of occupation increases the maxima move progressively towards longer wave-lengths. Similar results are obtained with SrF_2 and BaF_2. For the smallest degrees of occupation, the u.v. displacement depends on the kations in the sequence Ca > Sr > Ba. C. B. A.

3. Adsorption of Molecular and Atomic Iodine on Quartz Glass. P. Hölemann and A. Braun. *Zeits. f. phys. Chem.* 34. *Abt.B.* 5. *pp.* 381–395, 1936.—An interferometric method is used to measure the adsorption of iodine on quartz glass at temperatures between 150° C. and 1000° C. and at concentrations between $1{\cdot}7 \times 10^{-5}$ and $3{\cdot}3 \times 10^{-5}$ gm./cc. At constant temperature the amount adsorbed is proportional to the concentration; with rise of temperature it decreases. Neglecting any possible variation of "active surface" with temperature, the heat of adsorption of molecular iodine is calculated to be 1·2 k.cal./mol. Above 850° C. the iodine is adsorbed almost entirely as atoms, the corresponding heat of adsorption being not less than 15 k.cal./mol. The active surface is considerably smaller for adsorption of atoms than for adsorption of molecules. The ratio of the areas of the two surfaces used in the determinations is obtained by measurement of the adsorption at room-temperature. New vapour pressure measurements by a dynamic method give results in agreement with previous data. L. A. W.

4. Adsorption of CO and CO_2 on MnO_2 at Low Pressures. F. Charachorin and S. Elowitz. *Acta Physicochimica*, 5. 3. *pp.* 325–354, 1936. *In German.*—The energetic inhomogeneity of the MnO_2 surface in the initial stages of adsorption is established, and the heat of adsorption is found to be constant over the inhomogeneous range. The energy of activation of the activated adsorption is variable, the minimum value being 6225 cal. Equations are deduced for the activated adsorption and for adsorption when the inhomogeneity of the surface is no longer effective.

The existence of activated adsorption of CO_2 at temperatures above 25° C. is demonstrated. C. B. A.

5. Adsorption on Ionic Lattices. I. M. Kolthoff. *J. Phys. Chem.* 40. *pp.* 1027–1040, *Nov.*, 1936.—In systematic studies of the adsorbent properties of ionic precipitates distinction has to be made between different types of adsorption. These various types are discussed from a qualitative and quantitative viewpoint. AUTHOR.

See also Abstracts 98, 101, 113, 238, 276, 295, 321.

ATOMIC AND MOLECULAR STRUCTURE.

6. Disintegration of Nitrogen by Slow Neutrons. W. E. Burcham and M. Goldhaber. *Cambridge Phil. Soc., Proc.* 32. *pp.* 632–636, *Oct.*, 1936.—The disintegration of N by slow neutrons is studied in photographic emulsions of different sensitivity, which enable an unambiguous distinction to be made between the emission of α-particles and protons. Evidence is obtained that the disintegration takes place according to the reaction $^{14}N + {}^{1}n \leftarrow {}^{14}C + {}^{1}H$ with a cross-section of about 10^{-24} cm.^{2}. AUTHORS.

7. Atomic Disintegration by Particles of Low Energy. E. H. S. Burhop. *Cambridge Phil. Soc., Proc.* 32. *pp.* 643–647, *Oct.*, 1936.—A source of ions consisting of a l.v. arc, yielding homogeneous ion currents of the order of $\frac{1}{2}$ mA at low potentials is described. With such a source, atomic disintegrations are observed with ion beam energies of less than 8 kV. Approximate values of the absolute yield for protons from the deuteron on deuterium disintegration, and α-particles from the protons on Li disintegration are obtained. AUTHOR.

8. Transmutation of Potassium, Chlorine and Phosphorus by Th C′ α-Particles. E. Pollard and C. J. Brasefield. *Phys. Rev.* 50. *pp.* 890–894, *Nov.* 15, 1936.—The transmutation of the three similar $(4n + 3)$ type elements K, Cl, P under α-particle bombardment is studied by observing the energy distribution of emitted protons. These are found to occur in groups corresponding to discrete values of the nuclear energy changes which are determined and tabulated. A general similarity between the behaviour of the three elements is observed; they each give groups with energy changes differing by 1·5 eMV on the average, which fit in with the groups from the similar type elements F, Na, Al as found by May and Vaidyanathan. The values 33·9799 ($\pm$ 0·0015) and 37·9753 ($\pm$0·0016) for the masses of S^{34} and A^{38} are deduced. AUTHORS.

9. Artificial Radioactivity of Copper, a Branch Reaction. S. N. van Voorhis. *Phys. Rev.* 50. *pp.* 895–897, *Nov.* 15, 1936.—The artificial radioactivity of longer half-life produced in Cu by deuteron bombardment is studied. It is found to emit both electrons and positrons in the ratio 1·6 to 1. The half-life is found to be 12·8 $\pm$ 0·1 hr. The excitation curve of positrons and electrons for deuterons of different energies is studied and found to agree with the theoretical expression of Oppenheinmer and Phillips. The upper limits of the energy distribution of the positrons and electrons are obtained from cloud chamber photographs, and are found to be 0·79 and 0·83 eMV respectively. The results are interpreted as showing that this activity is due to Cu^{64} which branches in disintegrating, going either to Zn or Ni. AUTHOR.

10. Period of Radioactive Phosphorus $_{15}P^{32}$. G. J. Sizoo and C. P. Koene. *Physica*, 3. *pp.* 1053–1056, *Dec.*, 1936. *In English.*—An ionisation method for the measurement of the relative intensities of

very weak activities is described, which has the advantage that the correction for the background ionisation is eliminated. The period of radioactive P was determined with this method and found to be $15 \cdot 0 \pm 0 \cdot 1$ days. AUTHORS.

11. Formation of Radio-Phosphorus (P^{30}). J. R. S. Waring and W. Y. Chang. *Roy. Soc., Proc.* 157*A*. *pp.* 652–661, *Dec.* 2, 1936.—The formation of radio-phosphorus (P^{30}) from Al by the bombardment of α-particles is studied for different energies of the bombarding α-particles. Both thin targets, *i.e.*, 1·25 mm. to 2·5 mm. stopping power, and thick targets were used. The resonance levels observed are discussed and compared with those found for proton emission. An explanation for the excitation curve is given in terms of Bohr's theory of the formation of intermediate products, and the results for proton emission are also discussed from the point of view of that theory. AUTHORS.

12. Radiations from Artifically Produced Radioactive Substances. Part II. γ-Rays from Several Elements. J. R. Richardson and F. N. D. Kurie. *Phys. Rev.* 50. *pp.* 999–1006, *Dec.* 1, 1936.—A method for measuring the energy and relative intensity of the γ-rays emitted by light radioactive elements is discussed. It depends upon the measurement of the momentum distribution of the Compton recoil electrons projected from a thin mica radiator situated in a cloud chamber traversed by a magnetic field. In the energy range from 0·5 to 5 eMV the distribution includes only those electrons whose initial velocity makes an angle of less than 10° with the path of the incident γ-ray. The theoretical distribution curves indicate an average expected half-width of about 250 kV. Experimental data have been obtained which completely validate the theory. The γ-radiations from A^{41}, Na^{24} and N^{13} have been investigated by this method. The A radiation appears to be monochromatic with an energy of 1·37 eMV. Na emits three lines at 0·95, 1·93 and 3·08 eMV, which are possibly interrelated. Also the two quanta annihilation radiation from the positrons of radio N was checked at 0·51 eMV. The results indicate that the method is quite satisfactory in the energy range from 0·5 to 3 eMV. [For Part I see Abstract 1910 (1936).] AUTHORS.

***13. Mass-Spectrographic Study of the Isotopes of A, K, Rb, Zn and Cd. A. O. Nier.** *Phys. Rev.* 50. *pp.* 1041–1045, *Dec.* 1, 1936.—A mass spectrograph is described with which a study of the isotopic constitution of A, K, Rb, Zn and Cd, has been made. A calculation is carried out which indicates that the radioactivity of K and Rb can best be explained by assuming that it is K^{40} in the case of K and Rb^{87} in the case of Rb which is undergoing decay. AUTHOR.

***14. Double-Focusing Mass Spectrograph and Masses of N^{15} and O^{18}. J. Mattauch.** *Phys. Rev.* 50. *p.* 1089, *Dec.* 1, 1936.—A correction. [See Abstract 4943 (1936).]

15. Energy and Intensity of Groups of Neutrons Emitted by Po + Be. G. Bernardini and D. Bocciarelli. *Accad. Lincei, Atti,* 24. *pp.* 132–138, *Sept.*, 1936.—Combining Chadwick's curve for the variation of the number of neutrons emitted from Be with the energy of the incident α-particles, with Bethe and Peierls' work on the cross-section of protons for neutrons, previous results of the writer [see Abstract 4947 (1936)] are shown to be consistent with the presence of three groups of neutrons of energies $4 \cdot 2 \pm 0 \cdot 1$, $6 \cdot 3 \pm 0 \cdot 1$ and $7 \cdot 8 \pm 0 \cdot 2$ eMV and of intensities in the ratio 1 : 3·5 : 10. F. C. C.

16. Slowing Down of Neutrons in Water. G. Horvay. *Phys. Rev.* 50. *pp.* 897–898, *Nov.* 15, 1936.—The diffusion of neutrons in water is considered, and a simple method is given which permits an approximate estimation of initial neutron energies when the final energy and the mean square distance of travel are known. AUTHOR.

17. Absorption and Diffusion of Slow Neutrons. E. Amaldi and E. Fermi. *Phys. Rev.* 50. *pp.* 899–928, *Nov.* 15, 1936.—The study of the absorption properties of slow neutrons establishes the existence of absorption bands which correspond to energy intervals sufficiently narrow to allow one to isolate relatively homogeneous neutron groups. In this work, several experiments are described and considerations designed to disclose the characteristics of the absorption and scattering properties of the various groups. Summary: (1) Introduction; (2) Measurements and their reduction; (3) Selective absorption; (4) Slow neutron groups; (5) Systematic absorption measurements; (6) Albedo; (7) Scattering of the neutrons of a single group; (8) Mean free path of the thermal neutrons; (9) Groups as a function of the distance from the source; energy ratios; (10) Passage of the neutrons from one group to another; (11) Behaviour of the groups near the surface of the paraffin; (12) Width of the energy bands corresponding to the groups. Total number of neutrons; (13) *Résumé* and discussion. AUTHORS.

18. Scattering of Neutrons by Matter. Parts II and III. L. S. Ornstein. *K. Akad. Amsterdam, Proc.* 39. 8. *pp.* 904–905 *and* 39. 9. *pp.* 1049–1053, 1936.—Continuing his previous work on the statistics of the scattering of neutrons by matter [see Abstract 4945 (1936)], the author obtains expressions for the number of neutrons which have suffered n collisions without capture, and also for the probability that the energy of the particles lies between certain limits after n collisions without capture. Expressions are determined for the number of neutrons with energies between the limits ϵ and $\epsilon + d\epsilon$, after they have suffered one, two or n collisions. Finally the probability that the energy of all particles should lie within these same limits is given. G. O. B.

19. Chemical Linkage. Part II. Absorption Spectra of Dipole Association Products. R. F. Hunter, A. M. Qureishy, and R. Samuel. *Chem. Soc., J. pp.* 1576–1580, *Nov.*, 1936.—The existence of additive complexes with nitrohydrocarbons has been explained on the basis of the formation of a coordinate link between the N atom of the amino-group and that of one of the nitro-groups. An alternative explanation is that these additive complexes are associations produced by van der Waals forces which are of 3 types: (*a*) the mutual attraction of two dipoles; (*b*) the attraction of a dipole to a neutral molecule arising from the induced moment produced by the polarisability of the latter, and (*c*) the attraction arising from mutual perturbation of fast-moving dispersion electrons. The present investigation compares the absorption spectra of such complexes with those of their components. The absorption curves of the addition complex were found to be mere superpositions of the curves of the first component on the second, and therefore indicate only a small interaction of some kind between the component molecules in the complexes showing that their chemical individuality is preserved in such associations. [For Part I see Abstract 3992 (1934)]. H. H. Ho.

20. Determination of Molecular Weights by the Ultracentrifuge. S. Oka. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 519–523, *Oct.*, 1936.—*In German.*—Lamm's equation [see Abstract 824 (1930)], viz. $\partial c/\partial t =$

$D(\partial^2 c/\partial x^2 + \overline{1/x}.\ \overline{\partial x^2/\partial x}) - \omega^2 s\ (x.\ \partial c/\partial x + 2c)$ where D is the diffusion constant and s is the sedimentation constant, is shown on applying an appropriate boundary condition at the bottom of the cell to be consistent with Svedberg's equation applying to the steady state, in which diffusion and sedimentation are in equilibrium. L. V. C.

See also Abstracts 161, 174, 216, 226, 236, 252, 253, 254, 256, 257, 267, 291, 357.

COLLOIDS.

21. Compact-Disperse Substances. H. W. Kohlschütter. *Kolloid Zeits.* 77. *pp.* 229–238, *Nov.*, 1936.—The distinction between discrete-disperse and compact-disperse substances is comprehensively studied as a general problem of structure and practical description. The two classes of substances are first comprehensively defined, the main distinction being that the compact-disperse substances control of units in a structure as against the separate units of the other class. Examples of the two classes are given in the cases of: Ag sol, graphite, α-Fe_2O_3 and $Ca(OH)_2$. The structural theory of disperse substances is then discussed. Special examples of compact-disperse substances are given to illustrate outstanding characteristics, viz. of precipitation reactions at boundary surfaces, of dehydration of a gel, of solidification of a gel structure, of transformations of solid substances with stratified lattice structure, and of polymerisation reactions. Finally the practical importance of compact-disperse materials is considered, *e.g.*, for recrystallisation purposes, absorption, catalysis, pulverisation, etc. H. H. Ho.

22. Dialysis in the Study of Colloids. Part III. Colloidal Prussian Blue. G. F. Mankodi, P. M. Barve and B. N. Desai. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 480–490, *Oct.*, 1936.—The cataphoretic speed of colloidal prussian blue (prepared by peptisation with oxalic acid) with the progress of dialysis first increases and then decreases, while the stability as determined by flocculation values with KCl continuously decreases. The cataphoretic speed on dilution first increases and then decreases in some cases while it continuously decreases in others; the stability on dilution is found to decrease continuously in all the cases. These results of dialysis and dilution are exactly similar to those obtained with colloidal ferric and thorium hydroxide investigated by Desai and co-workers. The changes in the cataphoretic speed and viscosity under different conditions show that neither the view of Dhar nor of v. Smoluchowski can individually explain the results. The idea of critical potential is supported. The cataphoretic speed of the sol decreases on ageing and exposure to sunlight, sols dialysed for short periods even coagulating when exposed to sunlight for 2 min. [For Part II see Abstract 886 (1934)]. AUTHOR.

23. Highly Dispersed Aerosols by Decomposition of Mercury Dimethyl. J. Harms and G. Jander. *Kolloid Zeits.* 77. *pp.* 267–269, *Nov.*, 1936.—Details are given of the photochemical decomposition of $Hg(Me)_2$ whereby highly dispersed aerosols are produced. The concentration, number of particles and average particle weight are evaluated in relation to the age of the aerosol and for different initial concentrations. The investigation is intended to be of general application to other systems. An analytical method for the determination of small quantities of Hg is included. H. H. Ho.

***24. Disperse Gases. R. Auerbach.** *Kolloid Zeits.* 77. *pp.* 161–167, *Disc.* 167, *Nov.*, 1936.—This paper deals with chemical reactions between a liquid and a gas for which 3 processes are available, *viz.* (1) dissolution of gas in liquid ; (2) spraying the liquid into the gaseous phase ; (3) trickling the liquid along solid boundary surfaces against a counter current of gas. The author now investigates process (1) in detail and first discusses the basis of the production of gas bubbles in liquids, *i.e.*, the formation of disperse systems. Following comes a description of various means of producing such symptoms, which is illustrated by 13 diagrams of apparatus and machines. Among the achievements are the formation of an extraordinarily highly dispersed air hydrosol on the one hand, and a wide range of disperse systems of controlled dimensions on the other. H. H. Ho.

25. Condition of Sparingly Soluble Substances in Gels. Part I. Silver Chromate in Gelatin. R. R. Khanolkar, P. M. Barve and B. N. Desai. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 468–479, *Oct.*, 1936.—Changes in the conductivity and colour of silver chromate in gelatin solution are studied. It is observed that by suitable adjustment of the (*i*) temperature of the experiments, (*ii*) pH of gelatin, (*iii*) concentration of the reactants ($AgNO_3$ and K_2CrO_4) and (*iv*) amount of gelatin, the conductivity may (*a*) not decrease at all till the colour remains yellow, (*b*) decrease some time after the colour change or (*c*) not change at all in spite of the colour change. Preliminary experiments on the precipitation of PbI_2 in agar have shown that the (*a*) temperature at which the experiments are carried out, (*b*) pH of agar, (*c*) amount of agar and (*d*) concentration of the reactants [$Pb(NO_3]_2$ and KI) have a very marked influence upon the times when the colour change and decrease in conductivity take place as in the case of precipitation of silver chromate in gelatin. AUTHORS.

***26. Ultramicro-Electrophoresis. G. E. van Gils and H. R. Kruyt.** *Kolloid Beihefte*, 45. 1–3. *pp.* 60–98, 1936.—The paper commences with a theoretical study of the distribution of liquid currents in an electrophoresis vessel as a consequence of electro-endosmose at the walls. A current distribution formula is then derived for vessels of round and rectangular cross-section, whereby the current is conceived as the superposition of an electro-endosmotic current, by which the total liquid column is displaced over a definite distance, and a hydrostatic counter-current. The basis upon which the construction of an efficient electrophoresis vessel depends is next discussed, and special attention is devoted to the rapid installation of the hydrostatic counter-current. The formula now derived has been experimentally tested and complete details are given. Finally a new electrophoresis apparatus is described, and the errors of working are discussed and methods for their avoidance suggested. H. H. Ho.

27. Double Mobility of Cellulose Nitrate Sols. A. de Waele and G. Dinnis. *Physics*, 7. *pp.* 426–431, *Nov.*, 1936.—The ratio of the mobility of nitrocellulose solutions at high shearing stresses to the mobility at low shearing stresses, where there exists in fact true fluidity, is called the " mobility ratio." This mobility ratio may be very high for certain " medium " and " high viscosity " nitrocottons, but it does not necessarily prove to be a figure proportional to the usually accepted " viscosity." Thus mixtures of " high " and " low " viscosity nitrocottons may be so blended that, although showing similar low shearing stress viscosities with the falling ball, one will show at high shearing stresses much higher viscosity than the other. Certain " low " viscosity nitrocottons appear to show a nearly constant true viscosity at all rates of shear. The two mobilities

show significant differences in technical behaviour. Thus under given conditions of use, such as spraying, brushing, roller coating, etc., the high stress mobility determines what may be called the solvent demand of the sol, whereas the viscosity at low stresses indicates the characteristics to be expected after application. AUTHORS.

28. Gelation of Bentonite Suspensions. G. Broughton and L. Squires. *J. Phys. Chem.* 40. *pp.* 1041–1053, *Nov.*, 1936.—Two methods have been developed for measuring the rate of gelation of bentonite suspensions. The first measures the time elapsed after the suspension has been shaken before a tube containing it can be inverted without flow. In the second the velocity of fall of a sphere through the suspension is measured at different times after shaking. Both give results qualitatively in agreement but the latter method is preferred, since it is independent of the diameter of the containing vessel and gives the entire gelation-time curve. The results are found to be in conflict with the water-hull theory of gel structure and to be qualitatively in agreement with the mechanical theory, in which the gel is pictured as made up with bentonite plates of molecular thickness touching in completely random, three-dimensional orientation. AUTHORS.

29. Spinnability of Liquids. H. Erbring. *Kolloid Zeits.* 77. *pp.* 213–219, *Nov.*, 1936.—The work described previously [see Abstract 4466 (1936)] is re-surveyed with few additions. In a *Discussion*, **Ubbelohde** stressed that for the majority of systems studied the operative values of surface tension are dynamic rather than static and the author referred to parallelisms between spinnability and adhesive value. L. V. C.

30. Breaking Emulsions by Freezing. T. G. Rochow and C. W. Mason. *Indust. and Engin. Chem.* 28. *pp.* 1296–1300, *Nov.*, 1936. —Microscopical examination of emulsions of $C_6H_6 - CCl_4$ in water with such emulsifying agents as sodium oleate, saponin and triethylammonium oleate established the following points (*i*) the function of the emulsifying agent is not so much to lower the interfacial tension between the components as to protect the emulsion once formed (*e.g.*, by mechanical means) by the formation of oriented plastic layers around the internal phase; (*ii*) so long as the continuity of these layers is unaffected the emulsion remains stable; (*iii*) " breaking " of the emulsion by freezing is caused, in the main, either by removal of water from these layers with consequent loss of orientation, or by decrease in film area (followed by puckering) and coalescence of droplets (distorted by pressure during freezing) as soon as thawing of the ice permits them to change shape. L. V. C.

See also Abstracts 20, 237, 303, 365, 370, 390.

CRYSTAL STRUCTURE AND PROPERTIES.

31. X-Ray Analysis of Copper-Gallium Alloys. E. Zintl and O. Treusch. *Zeits. f. phys. Chem.* 34. *Abt. B.* 3–4. *pp.* 225–237, *Nov.*, 1936. —The α phase extends up to 20 atomic % Ga, from 20–24 atomic %, α, μ and δ are present. μ has probably a close-packed hexagonal lattice $a = 2{\cdot}594$, $c = 4{\cdot}229$ Å; δ is Cu_9Ga_4 agreeing with the 21 : 13 rule, with a cubic structure identical with γ brass, $a = 8{\cdot}711$ Å. The ϕ phase has only a narrow stability range at 58 atomic % Ga, with a tetragonal lattice, $a = 2{\cdot}830$, $c = 5{\cdot}831$ Å. There are 3 atoms in the unit cell in positions 000, $\frac{1}{2}\frac{1}{2}y$, $\frac{1}{2}\frac{1}{2}x$, ($y = 0{\cdot}27$, $x = 0{\cdot}70$). Probably this is based on the compound $Cu\,Ga_2$, itself non-existent when pure. D. R. H.

32. Structure of Compounds of Sodium with Tin and Lead. E. Zintl and A. Harder. *Zeits. f. phys. Chem.* 34. *Abt.B.* 3–4. *pp.* 238–254, 1936.—Well-formed crystals are obtained by melting together Pb or Sn and excess Na and removing the latter with liquid NH_3. $Na_{15}Sb_4$ is rhombic, $a_1 = 9{\cdot}79$, $a_2 = 22{\cdot}78$, $a_3 = 5{\cdot}56$ Å with 38 atoms per unit cell. $Na_{15}Pb_4$ is cubic with $a = 13{\cdot}29$ Å, occurring in space group T_d^6 with a $Cu_{15}Si_4$ lattice, 16 Pb in position c ($u = 5/24$), 12 Na in position a, 48 Na in position e ($x = 0{\cdot}12$, $y = 0{\cdot}16$, $2{=}0{\cdot}96$). Each Pb is surrounded by 12 Na, which are arranged in a pseudo close-packed cube. D. R. H.

33. Transformations in Metals by Heating in Air or Vacuum. J. J. Trillat and S. Oketani. *Comptes Rendus*, 203. *pp.* 1064–1066, *Nov.* 23, 1936.—If Au leaf, 50–70 $\mu\mu$ thick, is heated in A or N at about 500° for 1–2 hr., the electron diffraction method shows its structure to be altered, the lattice being now hexagonal with a 5·28 Å, and the c axis perpendicular to the plane of the leaf. This is due to mobility of the surface atoms at a temperature far below the melting point . Ag behaves similarly, as also does Au in air or O_2. If, however, a trace (*e.g.*, 1 %) of Cu is present, on heating to 400–500° a complex diagram due to oxidation appears. This gradually disappears when heated in a vacuum, or spontaneously at the ordinary temperature after several years. Al, Cu, and Fe forms stable oxides, not reversible on heating in a vacuum. Pt shows no change. C. A. S.

34. Texture of Thinly Rolled Tungsten Foil. W. G. Burgers and J. J. A. P. van Amstel. *Physica*, 3. *pp.* 1064–1066, *Dec.*, 1936. *In English.*—Electron diffraction photographs of very thinly rolled W foil show the presence of a pronounced rolling texture, the crystallites lying with a cube plane parallel to the plane of the foil and a cube edge (with very little spreading) at 45° to the direction of rolling. On oxidation, an oxide layer is formed consisting of crystallites oriented at random.

AUTHORS.

35. Crystal Lattice and Twins in Leucite. J. Wyart. *Comptes Rendus*, 203. *pp.* 938–939, *Nov.* 9, 1936.—The lattice constants are $a = 12{\cdot}95$; $c = 13{\cdot}65$ Å. The basis cell contains 16 molecules of $KAlSi_2O_6$, with an observed density of 2·480 (calc : 2·516). Twinning is indicated for 120° rotation about the axis of ternary pseudo-symmetry. Analogies with analcime are discussed. F. I. G. R.

36. Structure of Silver Nitrite. J. A. A. Ketelaar. *Zeits. f. Krist.* 95. *pp.* 383–393, 1936.—$AgNO_2$ is rhombic, the unit cell has a $3{\cdot}50_5$, b 6·14, c 5·16 Å, and contains 2 molecules ; space group C_v^{20} (Perhaps D_{2h}^{13}). The distance O–O in the same NO_2 group is 2·05 Å, in different groups 3·25, N–O = 1·14, metal-N (shortest) = 2·04, metal-O (of nearest NO_2 group) = 2·74 ; the corresponding distances in $NaNO_2$ are 2·08, 3·28, 1·13, 2·78 and 2·46. The angles ONO are respectively 126° and 132°. Thus in $AgNO_2$ the metal is bound to the NO_2 group by the N atom, in $NaNO_2$ by an O atom. C. A. S.

37. Structure of Silver Azide. C. D. West. *Zeits. f. Krust.* 95. *pp.* 421–425, 1936. *In English.*—AgN_3, density 4·50, is orthorhombic (pseudotetragonal), α 1·80, β and $\gamma > 2{\cdot}05$, birefringence strong and negative. The unit cell has a 5·89, b 5·58, c 5·96 Å, and contains four molecules ; space group V_h^{26}. Each Ag ion is at the centre of two unequal distorted tetrahedra of N atoms, one at 2·52, the other at 2·82 Å. The N_3 ion is linear symmetrical with N–N = 1·16 Å [see Abstract 4813

(1935)]. TlN_3 is tetragonal, isomorphous with KN_3, with a 6·21, c 7·37 Å. C. A. S.

38. Structure of Zinc Bromate Hexahydrate. S. H. Yü and C. A. Beevers. *Zeits. f. Krist.* 95. 5–6. *pp.* 426–434, 1936. *In English.*—A structure is proposed for the crystal $Zn(BrO_3)_2 \cdot 6H_2O$. This structure, based on the space group $Pa3$ (T_h^6), consists of pyramidal BrO_3 groups and octahedral $Zn \cdot 6H_2O$ groups, arranged on the three-fold axes of the space group. The structure of water bonds found is in complete agreement with previous work in spite of the fact that it resulted from the intensities without considerations of mechanical "fit." Elimination of diffraction rings of the heavy atoms on the Fourier projection in order to get accurate estimates of the parameters of the light atoms was employed. AUTHORS.

39. Oriented Oxidation of Barium. W. G. Burgers and J. J. A. P. van Amstel. *Physica*, 3. pp. 1057–1063, *Dec.*, 1936. *In English.*—Layers of metallic Ba were obtained by volatilising the metal in the (evacuated) electron diffraction apparatus and depositing it on a flat polished Cu disc. Depending on the conditions of evaporation (temperature), they show either random orientation of the crystallites, or a preferential orientation characterised by a [111]-direction perpendicular to the plane of the supporting disc. The oriented layers, on oxidation, yield likewise oriented oxide layers. In these latter, the normal to the support is nearly parallel to a [110]-direction of the oxide lattice, deviating from it by about 10°–15° towards [100]. It is thus found that a direction of closest packing of the metal atoms in the face-centred oxide lattice (*i.e.*, a [110]-direction) is closely parallel to a corresponding direction in the body-centred metal lattice (*i.e.*, a [111]-direction). The relationship is further discussed in connection with that found by Mehl, McCandless and Rhines to occur between FeO and Fe on oxidation of a single crystal of iron. It was found that the [111]-direction in the oriented Ba layers, formed under conditions of oblique incidence of the vapour beam, deviates slightly from the normal to the supporting disc towards the direction of the incident beam, a behaviour analogous to that observed previously with layers of CaF_2, deposited in vacuum from the vapour. AUTHORS.

40. Absorption of Polar Crystals in the Infra-Red. M. Blackman. *Roy. Soc., Phil. Trans.* 236*A*. *pp.* 103–131, *Nov.* 24, 1936.—The features of the spectrum of a 2-dimensional square lattice containing two particles per cell—especially the splitting of the frequency branches into acoustical and optical branches—are studied; the corresponding features of the 3-dimensional case are also obtained. This information is applied to a consideration of the properties of the infra-red spectrum of polar crystals. Good agreement with experiment is obtained for NaCl, but the results for KCl are not so satisfactory. Various possibilities of explaining the discrepancy are discussed. AUTHOR.

41. Influence of Liquids upon the Refractive Index of Clay Minerals. F. A. van Baren. *Zeits. f. Krist.* 95. 5–6. *pp.* 464–469, 1936. —For clay minerals, the refractive index can depend upon water content. (NH_2) groups constitutionally linked raise the index. F. I. G. R.

42. Crystal Symmetry Determinations by Means of Polarisation Colours Obtained with Crossed Nicols. M. v. Schwarz and H. Daschner. *Zeits. f. Metallkunde*, 28. *pp.* 343–346, *Nov.*, 1936.—The authors develop the theory of the colour changes observed on the polished surface of alloys when they are rotated between crossed nicols. The dependence of these colours on the crystal symmetry of the specimen is

expressed in the form of an equation, and it is shown that in certain cases by observing the colour changes and the dispersion when the specimen is rotated between crossed nicols, it is possible to say whether the crystals are isotropic, uniaxial or biaxial. Examples of the application of the method to five non-ferrous alloys are given. J. I.

43. Employment of Contoured Graphs of Structure-Factor in Crystal Analysis. W. L. Bragg and H. Lipson. *Zeits. f. Krist.* 95. 5–6. *pp.* 323–337, 1936. *In English.*—The use of contoured graphs of structure-factor in X-ray analysis of crystals is described. Such graphs make it possible to read values of the structure-factor for any given reflection *hk*, for an atom at any coordinates *xy* in the projection of the structure on a plane. They greatly reduce the labour involved in the search for an atomic arrangement which accounts for the observed intensities of reflection. It is shown that the total number of formulæ required for projections of all symmetries is small. A list of the formulæ is given, and typical examples of the corresponding graphs are reproduced. AUTHORS.

44. Elimination of Systematic Errors in Powder Photographs. A. Ieviņš and M. Straumanis. *Zeits. f. Krist.* 95. 5–6. *pp.* 451–454, 1936.—It is maintained that Cohen's method is only capable of good results in special cases [see Abstract 3436 (1936).]. F. I. G. R.

***45. Universal X-Ray Photogonimeter. R. B. Hull and V. Hicks.** *Rev. Sci. Instruments,* 7. *pp.* 464–467, *Dec.*, 1936.—A compact apparatus for making Laue, rotation, and Schiebold-Sauter photograms, without the intermediate transfer of the crystal, has been constructed. Back reflection photograms may also be made. An accurate horizontal scale and verniers, combined with a microscope which may be used as an auto-collimating telescope, facilitates the adjustment of the crystal, and permits interfacial angle measurements. All essential parts are readily adjustable with respect to the goniometer axis. AUTHORS.

See also Abstracts 240, 297, 345, 360, 366, 375, 376, 377, 379, 387.

DENSITY.

See also Abstracts 215, 270, 275, 297.

DIFFUSION AND OSMOSIS.

46. Diffusion of Gases Through Metals. Jwu-Shi Wang. *Cambridge Phil. Soc., Proc.* 32. *pp.* 657–662, *Oct.*, 1936.—The results of experiments on the diffusion of H_2 through metals from a pressure p on one side to a vacuum on the other show that at high pressures the amount diffusing varies linearly with $p^{\frac{1}{2}}$, but that at low pressures it varies more rapidly. The difficulty usually encountered when diffusion from an adsorbed layer into the solid is considered theoretically is that the theory indicates that saturation should be reached. In this paper it is shown that this difficulty is due to the omission of an important process at the surface and that by including this process the experimental results can be explained. AUTHOR.

47. Diffusion Study of Dyes. S. Lenher and J. E. Smith. *J. Phys. Chem.* 40. *pp.* 1005–1020, *Nov.*, 1936.—To study the relationship of substantive dyeing of cotton to the colloidal state of dyes in solution the microdiffusion method of Fürth and Ullman and the porous plate method of Northrop and Anson are used. Four representative dyestuffs

are examined the first being characterised as level dyeing, poor washing fastness and exhaust from the dyebath on cotton. The second has the reverse properties. The differences in behaviour indicate that the first closely approaches the molecular state in solution whilst the second is aggregated into micelles. The data now presented indicate that the representative acid and substantive dyes studied, except the second, in the absence of electrolytes are close to the molecular state. Inorganic electrolytes agglomerate both types of colours, substantive dyes being much more strongly aggregated than are acid dyes at the same concentrations. Dyestuff data record that a number of substantive dyes are aggregated to micelles of at least 100 molecules in $N/10$ NaCl, but the present work shows the aggregation of substantive dyes at the boil in $N/10$ NaCl is less than ten molecules per micelle, and that in most cases dyes approach the molecular state under practical dyeing conditions. Present data do not support a mechanical theory of dyeing, and it is probable that best levelness and penetration are achieved in dyeing when the particle size of the micelles is nearest the molecular state. Probably the forces leading to agglomeration of molecules of substantive dyes into micelles are identical with those instrumental in causing adsorption of the dye by the cellulose. S. G. B.

ELASTICITY AND PLASTICITY.

48. Stress in a Twisted Circular Cylinder Having Circular Holes. M. Kondô. *Phil. Mag.* 22. *pp.* 1089–1108, *Dec.*, 1936.—The torsion problem is solved mathematically for a circular cylinder having a number of circular cylindrical holes symmetrically situated about the axis, with the axes of the holes equidistant from the axis of the cylinder. The method employed is equivalent to taking vortex sheets of unknown strength on the surface of the cylinder and of the holes in the analogous hydrodynamical problem, the strengths then being expanded in Fourier series, and the coefficients found from the boundary conditions. Results are presented graphically, as figures of the lines of shearing stress, and graphs of the resultant tangential traction against azimuth for various radii, for 2, 3 and 4 holes, with radii $\frac{1}{4}$ of that of the cylinder, and axes distant $\frac{1}{2}$ the radius of the cylinder from its axis. S. G.

49. Stresses in an Infinite, Aeolotropic Plate with an Elliptic Hole. S. Lechnickij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 4. 3. *pp.* 111–115, 1936. *In German.*—The paper deals mathematically with the equilibrium of a homogeneous aeolotropic body, whose material possesses elastic symmetry at every point of a plane, so that the stress-strain relations involve 13 independent constants. For a state of plane stress or of plane strain, the stress function can be expressed by means of functions of $x + \mu_r y$, where the μ are roots of a certain equation. For the problem specified in the title, the case being that of plane stress, with given tractions at the boundary of the hole, transformations enable functions of the complex variable $x + iy$ to be used, and the ellipse is then transformed into a circle and a formal solution given. S. G.

50. Physical Phenomena at High Pressures. M. Sansoni. *N. Cimento*, 13. *pp.* 326–338, *July*, 1936.—The theoretical significance of high-pressure investigations of physical properties is reviewed, with special reference to Bridgman's work. Compressibility, thermal dilatation and phase equilibrium are discussed in some detail, while among other properties mentioned are viscosity and thermal and electrical conductivities.

Their bearing on modern physical theory is considered, and it is concluded that it is possible to offer only a tentative, qualitative wave-mechanical explanation of the observed phenomena. C. J. B. C.

51. Absolute Viscosity and Penetration of Asphaltic Bitumens. R. N. J. Saal and J. W. A. Labout. *Physics*, 7. *pp.* 408–412, *Nov.*, 1936.—The relationship between absolute viscosity and penetration for asphaltic bitumens has been reinvestigated. With purely viscous materials in a wide range of penetration figures (5 to 250) a general relation exists. It is found, however, that the depth of penetration depends somewhat upon the conditions under which the measurements are made. Inadequate adhesion of the bitumen to the penetration needle increases the penetration. This effect, however, is not great and is the same for all purely viscous bitumens of the same penetration. Penetration depth determinations were also made with elastic bitumens. Here the final penetration depth is increased by interruptions of the determination as a consequence of the dissipation of the elastic tension during interruption. It is concluded that Traxler, Pittman, and Burns [see Abstract 1391 (1935)] in their experiments have overlooked the elastic behaviour of some of their bitumens and that therefore their criticism of the relation deduced by us between penetration and absolute viscosity is not valid. AUTHORS.

***52. Rheology of Raw Rubber. M. Mooney.** *Physics*, 7. *pp.* 413–420, *Nov.*, 1936.—A viscometer of the rotating cylinder type is described which is applicable to rheological measurements of raw rubber. To make the instrument operative with such material the surfaces of the cylinders are fluted, to form rough, gripping surfaces; and pressure devices are added which compress and confine the rubber between the cylinders. At low or moderate stresses the rate of wear in hot, raw rubber follows the equation $\dot{a} = A\sigma^2$. At higher stresses the rate of shear increases more rapidly with increasing stress. The elastic recovery of hot, raw rubber requires over 5 hr. for completion. During most of this time the recovery angle follows the law $a = A + B \log t$. The modulus of rigidity in small deformations of hot, raw rubber is only slightly less than that of soft, cured rubbers at room-temperature. The viscosity of a sample of hot, raw rubber in vibration is many times less than the viscosity of the same sample in continuous shear. AUTHOR.

53. After-Effect of Drift in Rubber Under Constant Load. M. L. Braun. *Physics*, 7. *pp.* 421–425, *Nov.*, 1936.—Similar vulcanised rubber bands were subjected to four different tensions which produced immediate strains of approximately two to five times their original length. During the life of the bands this elongation was augmented an additional 100 or 200 % by the so-called after-strain or drift. Observations were taken at constant temperature. The average life of the bands was about 33 weeks. No correlation was found between the magnitude of the load and the time that the specimen could bear its load. Drift for all stresses continued to the breaking point. In all cases the initial time rate of drift was comparatively high. It declined with time to a positive minimum, passed through an inflection, and then steadily increased for the remaining life of the band. The inflection occurred after some weeks or months of drift. No correlation was found between the magnitude of the load and the time of inflection in the drift rate. During the interval between 1 and 80 min., the magnitude of the drift in at least one specimen was directly proportional to the log of the time. It then deviated from the log law and for three weeks closely followed a decreasing power law. AUTHOR.

54. Flexural Vibrations of Rectangular Plates with Free Edges. B. Pavlík. *Ann. d. Physik*, 27. 6. *pp.* 532–542, *Nov.*, 1936.—The method of Ritz is applied to study mathematically the vibrations of a plate in the shape of a parallelogram with free edges according to the Poisson-Kirchhoff theory, with Kirchhoff's boundary conditions, the functions used being the characteristic functions for the vibrations of a bar. The equations for a rectangular plate appear as a particular case, and certain errors in the Breslau dissertation (1918) of E. Goldmann are mentioned. Ten modes of vibration of a certain plate were computed ; and the vibrations of this plate and one other were studied experimentally, the plates being set in vibration by an effect of magnetostriction, as described in a previous paper by the author [see Abstract 3450 (1936)]. For the lower modes the calculated and measured frequencies agree fairly well, with the calculated ones slightly too high. For the higher modes, the calculated frequencies are definitely too high. Photographs are also given of dust figures. One of the theoretical results is that the nodal lines are approximately parallel to a side of the plate, or composed of combinations of such parallels—a result also to be seen in a general way from the experimental results. S. G.

55. Computation of the Strength of Windows. A. F. Dufton. *Phil. Mag.* 22. *pp.* 1165–1167, *Dec.*, 1936.—A nomogram is described for computing the strengths of windows from the formula $4ft^2 = 3p[1 - 5a^2b^2/6(a^4 + b^4)]\ [a^4b^2/(a^4 + b^4)]$, where p is the uniform pressure which the panes will bear, a the length, b the breadth and t the thickness of the pane and f the modulus of rupture. This is a more accurate formula than that previously used for this computation [see Abstract 4847 (1934)]. It is also recommended to use a factor of safety which will provide for a definite risk of failure. R. L.

***56. Laboratory Experiment on the Analysis of Forced Vibrations. P. L. Copeland.** *Am. Phys. Teacher*, 4. *pp.* 128–129, *Sept.*, 1936. —In student experiments on forced mechanical vibrations the use of an illuminated stroboscope with contactor operated on the shaft of the eccentric supplying the exciting force permits the analysis of the amplitude into the components in phase and out of phase with the applied force. Special apparatus for the analysis of forced vibrations is described and representative results are given. AUTHOR.

See also Abstract 216.

GRAVITATION.

57. Gravity and Isostasy in Canada. A. H. Miller and W. G. Hughson. *Dominion Observat. Ottawa, Publ.* 11. 3. *pp.* 81–134, 1936.—About one-third of Canada has been covered by 128 gravity stations established in the southern part of Canada and in the basin of Mackenzie river. Reductions by the Free Air, Bouguer, Hayford, and Airy methods show that the area as a whole is in practically complete isostatic equilibrium. This also applies to British Columbia and to the mountainous part of Alberta. The results agree somewhat better with the Airy than with the Hayford reduction. The most probable depths for both methods have been computed separately for 22 stations in the mountains as well as for 126 stations, the total number reduced isostatically. All the important results are tabulated and are in part shown graphically in two curves and on a gravity map which shows the anomalies for both United States and Canadian stations. AUTHORS.

***58. Instrument to Facilitate Calculation of Gravity. N. Szecsödy and J. Renner.** *Beitr. z. angew. Geophys.* 6. 3. *pp.* 307–310, 1936. —The instrument consists of a protractor graduated in radians, the diameter of which is continued in one direction by a ruler graduated logarithmically. A second similar ruler can be rotated about the centre of the protractor. The instrument is figured and its use described for determining the effect of two-dimensional disturbing subterranean masses on gravity at a point on the surface. C. A. S.

See also Abstract 92.

HYDRODYNAMICS AND AERODYNAMICS.

59. Applications of Conformal Transformation to Airscrew Theory. F. L. Westwater. *Cambridge Phil. Soc., Proc.* 32. *pp.* 676–684, *Oct.*, 1936.—Recent reports contain tables of a parameter K required in calculating the performance of an airscrew by a new method. The method of calculating K (due to Goldstein) is unsuitable for large values of the pitch especially near the tip of the airscrew. In the case of infinite pitch we fall back, for a two-bladed airscrew, on the problem of a rotating lamina in two dimensions. The solution for a cross lamina (corresponding to a four-bladed propeller) is given and the tables of K for four blades are completed. A formula for the limit of K/K_p at the airscrew tip is given for a propeller with any number of blades, where K_p is an approximate value of K due to Prandtl. K for any number of blades is given in the form of an infinite series. The case of 3 blades is discussed in detail. AUTHOR.

60. Instability and Breaking Up of a Ring of Liquid into Small Drops. S. Oka. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 524–534, *Oct.*, 1936. *In English.*—Mathematical. A drop of liquid placed in the surface of another opens into a ring as it sinks ; if undisturbed this ring develops " varicosities," breaking into droplets, each of which in sinking repeats this sequence. The instability of such a ring (assumed of a non-viscous and incompressible liquid, subject to no influence by the medium) is discussed by the method of small oscillations in which surface tension is considered the only restoring force. As in Rayleigh's treatment of vibrating jets, it is found that the motion is unstable when the wave-length or spacing of the " varicosities " exceeds the mean circumference of the ring-section. A maximum instability is reached at a definite value of the wave-length, which is a function of the ratio α of the radius of the ring to that of the cross-section ; thus drops of a definite size are formed and their number increases with increasing α. [See following Abstract.] L. V. C.

61. Instability and Breaking Up of a Ring of an Incompressible Perfect Liquid. S. Tomotika. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 535–549, *Oct.*, 1936. *In English.*—The same problem [see preceding Abstract] is analysed with confirmatory results in two distinct ways, *viz.* (*i*) statically, considering the change in surface area (at constant volume) of such a ring when disturbed by an integral number of sinusoidal " varicosities " ; (*ii*) dynamically, applying Lagrange's equation to the potential and kinetic energies produced by a small initial disturbance and assuming the motion to be proportional to e^{qt}. As before, if m is the total number of varicosities in the ring and $\alpha = R/r$, the original undisturbed state of the ring is stable or unstable according as $m \gtrless \alpha$. Maximum instability (maximum q^2) occurs at a certain value of m, which thus fixes the number of droplets into which the ring breaks. L. V. C.

62. Slow Motion of Fluid. W. R. Dean. *Cambridge Phil. Soc., Proc.* 32. *pp.* 598–613, *Oct.*, 1936.—The paper contains the mathematical solution of the problem of the slow two-dimensional motion of a viscous incompressible fluid bounded by an infinite plane containing a sharp projection in the shape of a plane of finite length at right angles to the infinite plane. Apart from the disturbance caused by the projection, the motion is taken to be a uniform shearing motion at right angles to the projection. The inertia terms in the equations of motion are neglected, so that the stream-function is a biharmonic function. The form of the solution found ensures that all the boundary conditions are satisfied exactly except the condition of no slip on the projecting plane : an infinite number of constants (the coefficients in an infinite series of functions) are to be found to satisfy this last condition. The first six constants are found numerically, the others being taken as zero, this being sufficient to make a function, whose vanishing expresses the condition of no slip, zero with zero derivatives to the tenth order at the edge of the projection, and it is checked numerically that the residual velocity of slip is then very small. If the stream function is expanded near the edge, a series of biharmonic functions giving zero velocity on the projecting plane is obtained. The pressure difference between points at the foot of the projection and on opposite sides of it is calculated as $2{\cdot}90\ \mu V/h$ (μ = viscosity, h = height of projection, V = velocity in undisturbed shearing motion at a distance h from the infinite plane boundary) in comparison with the less accurate result $3{\cdot}12\ \mu V/h$ found by the author in a previous paper. [See Abstract 3325 (1933).] S. G.

63. Forces on a Solid Body in a Stream of Viscous Fluid. T. E. Garstang. *Roy. Soc., Phil. Trans.* 236*A*. *pp.* 25–75, *Oct.* 20, 1936.—A solid body of arbitrary shape being held fixed in a stream of viscous fluid of constant density ρ, the undisturbed velocity of the stream being a constant U, it is assumed that Oseen's approximations hold at a large distance from the body, and the lift and drag forces on the body are calculated from considerations of momentum. The solution of the Oseen equations is discussed in detail by the method of series of solid spherical harmonics. It is known that the velocity may be divided into two parts, one irrotational and the other rotational and sensible only in the wake ; that for the irrotational velocity there is an outflow across a large sphere, with an equal inflow in the wake from the rotational velocity ; that the pressure p may be expanded in a series of solid spherical harmonics of negative degree, and when p is a sectorial harmonic, the corresponding irrotational velocities have singularities which have to be cancelled by the rotational velocities, these special discontinuous solutions being associated with lift forces. The solution for the irrotational velocities is discussed analytically in detail ; and general series expansions for the rotational velocities are given for the first time. For the discontinuous solutions in both cases an associated Legendre function is introduced, and its properties discussed. The known result that the drag is ρU times the inflow along the wake is recovered. It is shown that at a great distance there are (diffused) trailing vortices with equal and opposite circulations round two complementary halves of the wake, which die out as $r^{-1/2}$, where r is distance from an origin in the solid body, and that the lift force in the direction of the axis of y, for example, is in the sense to be expected physically, and is $2\rho(\pi\nu U)^{1/2} \lim r^{1/2} I$, where ν is the kinematic viscosity, and I the circulation round the half of the wake for which z is positive. It is also shown

that the lift forces are associated entirely with the special solutions occurring when p is a sectorial harmonic, and analytical formulæ are given. S. G.

64. Relative Motion of a Solid in a Viscous Fluid. V. Valcovici. *Comptes Rendus*, 203. *pp.* 1054–1056, *Nov.* 23, 1936.—The author is concerned to prove that the resultant hydrodynamic force system on a solid body Σ moving in any manner in a viscous fluid at rest at infinity, plus the system of inertia forces of the displaced fluid (supposed moving with the same velocities as Σ) is equivalent to the system of forces exerted by the fluid on Σ when a rigid body motion has been added to the whole system so as to annul the motion of Σ. For a motion of translation in an ideal inviscid incompressible fluid, the theorem has lately been proved by Neumark; the author points out that he published this result in 1914 and extended it to a uniform rotation of a solid in a viscous incompressible fluid in 1920. S. G.

65. Forces on a Circular Cylinder Submerged in a Uniform Stream. T. H. Havelock. *Roy. Soc., Proc.* 157*A*. *pp.* 526–534, *Dec.* 2, 1936.—A solution is given for the two-dimensional wave motion due to a circular cylinder in a uniform stream, taking fully into account the condition at the surface of the cylinder. Expressions for the horizontal and vertical forces on the cylinder are obtained in the form of infinite series in ascending powers of a certain parameter. Numerical calculations are made from these and compared with the known first approximations. The main effect of the additional terms upon the wave resistance is to increase the calculated value at low velocities and to decrease it slightly at high velocities. AUTHOR.

66. Uplift Pressures under Weirs with Three Sheet Piles. H. R. Luthra and V. I. Vaidhianathan. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 491–502, *Oct.*, 1936.—The uplift pressures under weirs with three sheet piles are determined. By studying the effect of varying the length and position of the intermediate sheet pile, working rules are obtained for the design of such weirs. [See Abstract 4999 (1936).]

67. Correlation Measurements in Turbulent Flow through a Pipe. G. I. Taylor. *Roy. Soc., Proc.* 157*A*. *pp.* 537–546, *Dec.* 2, 1936.—If u_1, u_2 are the velocity components parallel to the mean stream at any two points of a cross-section in turbulent flow along a pipe under a steady pressure difference, and R is the coefficient of correlation between them, it is shown that, if u_1 is taken at a fixed point, $\int \mathrm{R}\, u'_2\, dS = 0$, the integral being taken over the cross-section of the pipe, and u'_2 being the r.m.s. value of u_2. Hence for a circular pipe of radius a, if u' is the r.m.s. value of u at radius r, and the fixed point is taken on the axis, $\int_0^a u'\, \mathrm{R}\, r\, dr = 0$. Measurement of R involves complexity of apparatus, and this equation provides a welcome check on the results. The results of measurements of R and u' right across a pipe of radius $1\frac{7}{16}''$ by L. F. G. Simmons are given. R is positive for $r < 0{\cdot}6''$, negative (and small) for $r > 0{\cdot}6''$. The positive contribution to the integral is 0·0098, the negative contribution − 0·0097. Near the axis, the observations of R lie fairly well on the parabola predicted by theory. A new method of measuring R is described. Two readings only are necessary in this method, which gives $1 - \mathrm{R}^2$ directly, and is particularly advantageous when R is nearly equal to 1. S. G.

68. Fluid Friction Between Rotating Cylinders. G. I. Taylor. *Roy. Soc., Proc.* 157*A*. *pp.* 546–578, *Dec.* 2, 1936.—The torque between concentric rotating cylinders is measured in two cases, (*a*) inner cylinder rotating, outer cylinder fixed, (*b*) inner cylinder fixed, outer cylinder

rotating. It is found, as was to be expected, that the critical speed at which turbulence begins is very much lower in case (*a*) than in case (*b*). The difference between the critical speeds in the two cases becomes rapidly greater as t/R_1 increases, t being the difference between the radii, and R_1 the radius of the outer cylinder. When $t/R_1 = 0{\cdot}38$ the ratio of the critical speeds in the two cases exceeds 1000, when $t/R_1 = 0{\cdot}1$ it is about 50, when $t/R_1 = 0{\cdot}017$ it is 6. It appears that t/R_1 must be less than $0{\cdot}001$ before the effect of rotation on the critical speed disappears. When the flow is turbulent the effect of rotation on the torque is small in case (*a*) but large in case (*b*). In case (*a*) the distribution of velocity between the cylinders has previously been measured. The far greater technical difficulty of measuring the distribution in case (*b*) has now been overcome by a new design for the inner cylinder due to W. S. Farren. It is found that the stabilising effect of rotation makes it possible for large gradients of velocity to exist throughout the space between the cylinders. The distribution is therefore more like that which is observed in non-turbulent flow than that observed in case (*a*), where nearly the whole velocity changes occur quite close to the wall. S. G.

69. Errors Due to Inclination of Paths of Fluid Particles in Gauging Flow with Current Meters. L. Escande and G. Sabathe. *Comptes Rendus.* 203. *pp.* 922–924, *Nov.* 9, 1936.—When the discharge of a stream is found by exploring a plane section of the stream with a current meter (and integration of the velocity), then, if the axis of the instrument is normal to the plane explored, variations in the direction of the flow will produce errors unless the velocity measured by the instrument is the component along its axis. Special experiments were made to test this point with a meter of the screw type by towing experiments with the axis along, and inclined to, the direction of relative motion. The percentage error $100\ (V_1\cos\lambda - V)/V$, where V is the velocity from the calibration curve at zero inclination, and $V_1\cos\lambda$ is the actual component along the axis, is plotted against velocity for inclinations of 10°, 20°, 30°, 40°, 50°, for velocities up to 3½ m./sec. for 10°, and less for higher inclinations. It is positive, and increases somewhat with velocity. At 3 m./sec. at 20°, it is as much as 10 %. For higher inclinations it rises rapidly. The instrument did not rotate at all for inclinations above 55°. S. G.

70. Parabolic Water Jets. J. Satterly and J. R. Levitt. *Roy. Soc., Canada, Trans.* 30. *Sect. III. pp.* 137–143, *May*, 1936.—In partial agreement with Levi-Civita (*Seminario Matematico e Fisico di Milano*, 5. *pp.* 1–20, 1931) it is shown that the curve of an inclined liquid jet is not parabolic. Experimental measurements indicate, however, that although the deviations from the parabolic are in the direction indicated by Levi-Civita, their actual values do not agree with his theoretical values. Authors.

71. Progressive Waves of Finite Amplitude and Steady Motions of an Elastic Fluid. H. Bateman. *Nat. Acad. Sci., Proc.* 22. *pp.* 607–619, *Oct.*, 1936.—A mathematical discussion is given of the equation for the variable motion in one dimension of a compressible inviscid fluid and the solutions representing plane progressive waves of finite amplitude, mathematical transformations of the equations and solutions being considered, and also the formation of shock waves. Analysis similar in part to that in the first section can be used to discuss steady flow in two dimensions. If, u v are the velocity components, p the pressure, ρ the density, there is a function S such that $\rho u^2 + p = -\partial^2 S/\partial y^2$, $\rho uv =$

$\partial^2 S/\partial x \partial y$, $\rho v^2 + p = -\partial^2 S/\partial x^2$, and the motions considered are those for which the second derivatives of S are all functions of a single parameter. The resulting equations had been previously studied by S. Lees and the present author, but the analysis is here presented in an improved form which shows more clearly its relation to the graphical methods for supersonic flow problems used by Prandtl, Ackeret and Busemann. (The solutions considered may be described as a generalisation of the Prandtl-Meyer solution.) Finally the spiral flow studied by G. I. Taylor is considered, and a method of graphical representation suitable for this and other types of flow is explained. S. G.

See also Abstracts 73, 76, 99, 111, 148, 188, 281.

KINETIC THEORY OF MATTER.

72. Brownian Motion of the Generalised Harmonic Oscillator. W. R. van Wijk. *Physica*, 3. *pp.* 1111–1119, *Dec.*, 1936. *In English.*—The distribution functions of the velocity and of the displacement of a harmonic oscillator, which moves under the influence of a variable external force and which possesses a mass, damping constant and binding force dependent on the time, are shown to be of the Gaussian type. The linear combinations of the velocity and of the displacement can be arranged into pairs of mutually independent combinations; their distribution functions are Gaussian functions as well. The distribution functions can be expressed in a closed form in terms of two particular solutions of the corresponding linear homogeneous differential equation of the second order. AUTHOR.

73. Mobility of Spherical Particles in a Gas. F. Ehrenhaft. *Comptes Rendus*, 203. *pp.* 850–852, *Nov.* 3, 1936.—An experimental study of the laws governing the fall of particles of known density and dimensions of the order of a few wave-lengths was made by measuring the rate of fall of spherical wax drops in an Ehrenhaft condenser and projecting the sphere on to a quartz slide in the condenser, where it is then photographed by u.v. light, whence its radius is determined microscopically. The rate of fall is measured for pressures of 1–15 atm. and the mobility is found to obey Stokes's law. N. M. B.

See also Abstracts 109, 260, 276.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 191.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

74. Recurrence Formulæ of Lamé Functions of Different Degrees. J. L. Sharma. *Phil. Mag.* 22. *pp.* 1123–1129, *Dec.*, 1936.—Almost all the functions occurring in harmonic analysis possess a property of satisfying recurrence formulæ, but curiously enough, so far, no such property has been investigated for Lamé functions, though they belong to the same class of functions. The object of the present paper is to supply this deficiency.

75. Sufficient Statistics and Intrinsic Accuracy. E. J. G. Pitman. *Cambridge Phil. Soc., Proc.* 32. *pp.* 567–579, *Oct.*, 1936.—It is proved that if there exists a sufficient statistic for the estimation of an unknown parameter of a population, the frequency function of the popu-

lation must be of a certain type. It is shown that some modification of previous theory of the intrinsic accuracy of statistics is necessary when the range of the population sampled is a function of the parameter to be estimated. Finally, the theory is extended to sufficient sets of statistics, *i.e.*, sets of statistics which together contain all the information provided by a sample about an unknown parameter. [See also Abstract 1857 (1934).] AUTHOR.

76. Extension of the Principle of the Limiting Law in Dimensional Analysis. R. Esnault-Pelterie. *Comptes Rendus*, 203. *pp.* 755–759, *Oct.* 26, 1936.—A discussion in general terms of the application of arguments from the dimensions of the involved quantities in finding the form of physical laws, with particular reference to approximate expressions when the form assumed by a law for zero values of one or more of the parameters is known. The formula for the discharge of liquid through an orifice is considered as an example. The quantities taken into consideration, besides the rate of discharge, are the area of the section of the orifice, the pressure fall, the density and viscosity of the liquid, the length of the orifice, and parameters to express the form of the orifice and the roughness of the surface of the orifice, but not the surface tension. S. G.

***77. Integrating Instruments. A. Walther.** *V.D.I.* 80. *pp.* 1397–1403, *Nov.* 21, 1936.—A short description of various types of planimeter and similar instruments, together with the mathematical principles underlying them, and a short Bibliography. P. H. B.

78. Theory and Experiment in the Exact Sciences. W. Gerlach. *Naturwiss.* 24. *pp.* 721–741, *Nov.* 13, 1936.—The author discusses the relation between theory and experiment and outlines, as illustration, the history of X-rays and kathode rays, of the radiation laws and of ortho- and para-hydrogen. He emphasises the important rôle which theory played in these discoveries. R. P.

See also Abstracts **63, 333.**

MECHANICS, CLASSICAL.

79. Certain Vibration Problems Solved by Means of an Analogous Problem in Heat Conduction. G. Green. *Phil. Mag.* 22. *pp.* 1079–1088, *Dec.*, 1936.—The wave-train method previously used by the author [see Abstract 4616 (1934)] is first applied to the following heat conduction problem. A large vessel, kept at zero temperature, is connected by a cylindrical rod to a mass having unit conductivity and uniform temperature. The temperature distribution throughout the connecting rod is determined at any instant after applying a steady supply of heat to the mass, losses by radiation and convection being neglected. It is then shown that an analogous treatment can be used to determine the motion of a mass suspended from a wire after it has been set in either elongational or torsional vibration. R. W. P.

See also Abstract 188.

MECHANICS, QUANTUM.

80. Successive Approximations in Quantum Mechanics. A. F. Stevenson. *Roy. Soc. Canada, Trans.* 30. *Sect. III. pp.* 75–83, *May*, 1936. —The method of successive approximations, analogous to the method of

Born in his theory of the scattering of particles by a static field, is applied to the determination of eigenvalues and eigenfunctions when the quantum mechanical wave equation is replaced by an integral equation. The analytical difficulties are considerable, and the method has only a restricted application. The problems considered are perturbations (and the special case of a central field) for a one-electron problem and its generalisation.

N. M. B.

81. Eigenvalues of Electromagnetic Angular Momentum. M. H. L. Pryce. *Cambridge Phil. Soc., Proc.* 32. *pp.* 614–621, *Oct.*, 1936.—It is shown that the eigenvalues of the angular momentum of the electromagnetic field containing a number of charged particles, apart from spin angular momentum, are only the integral multiples of $\hbar$. This is shown by using cylindrical polar variables, and taking a particular choice of the vector potential in which the radial component is zero, defined explicitly in terms of the magnetic field strengths. By expanding in terms of the Fourier functions $e^{in\theta}$, the angular momentum is separated out into terms independent of one another, each taking on only integral values in units of $\hbar$. The arguments all apply equally well to a modified field theory such as that of Born and Infeld. AUTHOR.

82. Wave Equation in Conformal Space. H. J. Bhabha. *Cambridge Phil. Soc., Proc.* 32. *pp.* 622–631, *Oct.*, 1936.—The invariance of the fundamental equations of physics under transformations of a four dimensional conformal space is studied. The four-dimensional space is regarded as a hyperquadric in a 5-dimensional projective space and the method of homogeneous coordinates is used. The invariance of Maxwell's equations and the wave-equation for an electron in the presence of a general electromagnetic field are especially dealt with. The paper contains a correction to some similar work carried out by Dirac. G. C. McV.

83. Quantum Mechanics and the Principle of Relativity. B. Kwal. *Comptes Rendus*, 203. *pp.* 983–984, *Nov.* 16, 1936.—In an attempt to make quantum mechanics agree with the principle of relativity, the hypothesis, that dynamical magnitudes can be represented by means of quaternary matrices, is used. Such an assumption and its application to quantum mechanics are shown to be mathematically tenable. G. O. B.

84. World Line Element in Relativistic Wave Mechanics. J. Mariani. *Comptes Rendus*, 203. *pp.* 1056–1058, *Nov.* 23, 1936.—Remarks on the fact that, owing to the uncertainty principle, the path of a particle, and hence also the geodetic line, cannot be defined. R. P.

85. Atomic Wave Functions for Two Stages of Ionisation of Silicon. H. L. Donley. *Phys. Rev.* 50. *pp.* 1012–1016, *Dec.* 1, 1936.—Normalised 1-electron wave functions and the corresponding fields, accurate to four decimal places, have been calculated by the self-consistent field method for the ions Si^{+2} and Si^{+3}. The values of the energy parameter associated with the various self-consistent field calculations have been compared with experimental values of the energy levels ν/R. The extent to which the core wave functions for Si are perturbed by the addition of an extra $3s$ electron is noted. AUTHOR.

86. Self-Consistent Field, with Exchange, for Cu^+. D. R. Hartree and W. Hartree. *Roy. Soc., Proc.* 157*A*. *pp.* 490–502, *Dec.* 2, 1936.—The numerical solution of Fock's equation for the self-consistent field, including exchange effects, for the Cu^+ ion is carried to a successful conclusion. The work is made rather troublesome by the very sensitive character of the $(3d)^{10}$ group, but otherwise presents no particular features

except its length. The results are given and the effects of the exchange terms discussed and compared with the corresponding effects for Cl^-; in both cases the most striking feature is a considerable contraction of the outermost (*nl*) group, accompanied by a comparatively small contraction of the other groups of the outer shell. The diamagnetic susceptibility is calculated and found to be in good agreement with experiment. [See Abstract 3490 (1936).] AUTHORS.

87. Relativistic Interaction of Two Electrons in the Self-Consistent Field Method. Bertha Swirles. *Roy. Soc., Proc.* 157*A*. *pp.* 680–696, *Dec.* 2, 1936.—The relativistic self-consistent field method is extended to take account of the interaction of the spins of the electrons and retardation. The method is applied to the evaluation of the separations of the 2^3P term of He, using a modification of Slater's method of "diagonal sums." The agreement with experiment is as good as can be expected with the wave functions used. [See also Abstract 4862 (1935).] AUTHOR.

88. Coulomb Interaction of Two Neutral Atoms. L. Goldstein. *J. de Physique et le Radium*, 7. *pp.* 466–468, *Nov.*, 1936.—Using approximate analytical forms for the statistical distribution potential functions and atomic charge (Fermi-Thomas atom), the Coulomb interaction energy of two neutral atoms, neglecting their mutual polarisation, is evaluated. For two different atoms the reaction energy R assumes a complex form, but for two identical atoms the ratio $R/Z^{7/3}$, where Z is the atomic number, is a simple universal function of the statistical variable, proportional here to the distance between the nuclei. N. M. B.

See also Abstracts 89, 161, 175, 296.

RELATIVITY AND ETHER.

89. Generalisation of the Lorentz Transformation for a System of Particles. J. L. Destouches. *Comptes Rendus*, 203. *pp.* 924–926, *Nov.* 9, 1936.—Results previously reported [see Abstract 4024 (1936)] are extended by the deduction of a generalisation of the Lorentz transformation, in conformity with the principle of relativity, for a system of independent particles. It is suggested that the result may serve to initiate a relativistic wave mechanics free from certain difficulties associated with the older form of relativistic mechanics of systems of material particles. N. M. B.

90. Rôle of Fresnel Drag in Airy's Experiment. A. Hammer. *Phys. Zeits.* 37. *pp.* 764–766, *Nov.* 1, 1936.—Reference is made to Airy's experiment in which he showed that aberration was independent of the interposed medium by putting in a telescope water instead of air and comparing the angle of aberration, with that obtained when air was the medium. The same angle was got in both cases. Airy's experiment and Fresnel's statement are discussed. Airy's result furnishes no support for the Fresnel drag and therewith for the refraction law for relative rays, for the result can be explained without this hypothesis. For an observer in air it is equally valid whichever direction the ray has in the water. For example, another drag than that of Fresnel might be assumed without the direction of the ray for the observer in air being in any way different. The refraction law for relative rays would then no more hold good as in that case no more carrying along is assumed. J. J. S.

91. Semi-Vectors in Born's Field Theory. B. S. M. Rao. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 436–451, *Oct.*, 1936.—The Lorentz-invariance of the equations connecting the primary and secondary vectors is proved in the cases where the action functions are U and V, and the Lorentz-invariance of the field equations derived from U and V follows as an immediate consequence. AUTHOR.

92. Kinetic Ether-Theory and its Numerical Foundations. H. Fricke. *Zeits. f. techn. Physik*, 17. 11. *pp.* 491–496, 1936.—The well-known stellar mass-luminosity law is used as evidence that the gravitating mass of a body is proportional to its temperature and, on this basis, a theory of gravitation is built up. G. C. McV.

See also Abstracts 81, 83, 84, 118.

SOLUTION.

93. Solubility of Nitrogen in Water at High Pressures. J. Basset and M. Dodé. *Comptes Rendus*, 203. *pp.* 775–777, *Oct.* 26, 1936.—The authors report a maximum solubility of 7 cc. N_2 (at N.T.P.) per gm. water at 18° C. under a pressure of 3000 kg./cm^2., their observations extending to 4500 kg./cm.^{2} Equilibrium was attained only after 80 hr.; while this was due in part to the low surface/volume ratio (0·1) of the system, contamination of the liquid surface by entrained oil from the compressors may have occurred. Further studies will be made to eliminate this possibility and extend the pressure-range. L. V. C.

94. Solubility of Gases in Molten Metals. H. v. Wartenburg. *Zeits. f. Elektrochem.* 42. *pp.* 841–845, *Dec.*, 1936.—Solubility of diatomic gases in molten metals is proportional to the root of the pressure. In general, equilibrium is attained by formation of chemical compounds, weakly endothermic or exothermic at room-temperature but with stability greatly increased in equilibrium with the monatomic gases. The process of solution of O_2 in Ag is investigated quantitatively from considerations of the chemical production of Ag_2O, determination of the molecular weight of dissolved Ag_2O by depression of the freezing point, and thermodynamic examination of the synthesis of Ag_2O from Ag and monatomic O. A number of systems *e.g.*, Ag-P., Fe-N_2, Fe-H_2, and hydride forming systems can be explained qualitatively. For Al-H_2 a reasonable value is obtained for AlH synthesis. Other systems of technical importance in casting, are not equilibria but supersaturated solutions. In such cases the gas is introduced by chemical reaction within the metal, independently of the atmosphere, *e.g.*, Fe-CO and Al-H_2, and the supersaturated solutions can be destroyed only by mechanical means. D. R. H.

See also Abstracts 237, 364.

SURFACE TENSION AND COHESION.

95. Phenomena Associated with a Vertical Jet of Mercury. J. Satterly and J. R. Levitt. *Roy. Soc. Canada, Trans.* 30. *Sect. III. pp.* 129–135, *May*, 1936.—To obtain consistent results for the surface tension of Hg by the method of a vertical jet directed into a Hg reservoir, small jets and small rates of flow should be used. A value of 510 ± 10 dynes per cm. has been obtained. With small flows an interesting example of a *vena contracta* is obtained just above the level of the Hg in the reservoir. AUTHORS.

96. Two-Dimensional Gases, Liquids and Solids. I. Langmuir. *Science*, 84. *pp.* 379–383, *Oct.* 30, 1936.—An elementary account of the properties of surface films. C. B. A.

97. Polymolecular Films: Mixed Films with Two or More Components. Part I. R. J. Myers and W. D. Harkins. *J. Phys. Chem.* 40. *pp.* 959–971, *Nov.*, 1936.—A preliminary survey of films composed of fatty acids and tetradecane or Nujol has been made. The films containing Nujol exhibit many interesting characteristics, justifying further examination of films with two or more components. Authors.

***98. Hydrogen-Ion Concentration and Films on Water. W. D. Harkins and R. J. Myers.** *J. Chem. Phys.* 4. *pp.* 716–724, *Nov.*, 1936.—A method for determining the effect of H-ion concentration on the behaviour and measurement of monomolecular and polymolecular films on water is described. The trough used, and the film balance are described in detail. The technique of the measurements, precautions to be observed in adjustment of vapour pressure, cleanliness of the trough used, and the method for spreading the films are discussed. Curves showing the effect of time on the pressure-area relations of films of pentadecylic acid on water, and the effect of H-ion concentration on the pressure-area relations of films of myristic acid are given. The accuracy of the methods used is critically examined. F. J. B.

99. Movement of Contaminated Liquid Surfaces. R. Mérigoux. *Comptes Rendus*, 203. *pp.* 848–849, *Nov.* 3, 1936.—The mechanism of the motion of a liquid surface contaminated with a monomolecular fatty acid layer [see Abstract 4039 (1936)] is examined by allowing a trickle of water to run down an inclined plane dipping into a dish of water the surface of which is contaminated with oleic acid. It is observed that a wide flat drop rises up the plane as far as the point of impact of the trickle, that the acid film from the dish rises over the surface of the drop, and that a coefficient of friction exists between the film and the water circulating below it in the drop, varying with the rate of flow of the water, and thus with the velocity gradient of the water circulating under the film. This is considered with reference to the motion of a liquid in a rotating flask (*loc. cit.*), and values for the magnitudes concerned are deduced. N. M. B.

***100. Electrocapillarity—A Lecture Experiment. A. Thiel.** *Zeits. f. Elektrochem.* 42. *pp.* 879–880, *Dec.*, 1936.—A glass tube about 12 mm. wide and 45 mm. long has one end closed and hangs with its lower side horizontal in 0·1 *N* H_2SO_4 solution. A bead (0·1 cm^3) of Hg is placed at the closed end. When a crystal of $K_2Cr_2O_7$ is placed near to the open end it slowly dissolves. The Hg, on being reached by the solute, creeps towards the crystal and eventually ejects it from the tube, after which it slowly returns to the closed end of the tube. The experiment, which can be repeated with a new crystal, is referred to as the "mercury slug" (*Quecksilberschnecke*) and is stated to be as effective as the "mercury heart." P. H. B.

***101. High-Speed Motion Picture Camera for Research on Surface Tension. E. A. Hauser, H. E. Edgerton, B. M. Holt, and J. T. Cox, Jr.** *J. Phys. Chem.* 40. *pp.* 973–988, *Nov.*, 1936.—Pictures of the formation and fall of drops were taken at the rate of 1,200 per sec. Successive steps in the formation of drops and in the segmentation of "stems" observed to follow the drops were studied. The size of the main drop of a pure non-viscous liquid decreases with time of drop formation. The length of the stem increases with decrease of surface tension, but for

water containing capillary-active substances the length of the stem is shorter than that of pure water. An explanation of this is offered. The size of the secondary drops expressed in terms of the main drop increases materially with decreasing surface tension. The measurement of the oscillations of the secondary drops gives a new means of studying adsorption at freshly formed surfaces. The ring method was studied by means of photographs taken at the rate of 600 per sec. The influence of viscosity on the mechanism of the rupture is indicated. A new method of surface tension determination based on the measurement of the oscillations of the thin liquid film formed across the ring immediately after rupture is demonstrated. It is finally concluded that the phenomena connected with both the drop-weight and ring method are so highly complicated that neither method is ideal for accurate surface-tension determinations.

P. H. B.

See also Abstracts 60, 61, 113, 270, 297.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

***102. Conversion of Mean Solar Time to Sidereal Time. S. Baumbach.** *Zeits. f. Instrumentenk.* 56. *pp.* 469–471, *Nov.*, 1936.—It is pointed out that all existing simple systems of gearing for enabling clocks showing mean time to show also sidereal time, either involve tolerating large rates or else use pinions with a large number of teeth. A system is sought for which the annual error is less than 1 sec., and which employs not more than 3 pairs of wheels, each with fewer than 100 teeth. The sidereal-solar ratio 366·242201/365·242201 is given in the form of a continued fraction whose first 9 convergents are evaluated as fractions with factorised numerators and denominators. None of these satisfies all the requirements. The ratio $(43 \times 51 \times 82)/(31 \times 65 \times 89)$, however, is shown to give an error of 0·52 sec. per annum. The advantages of a system based on this ratio are discussed. A. Hu.

***103. Simple Laboratory Timer. H. Smith.** *Am. Phys. Teacher*, 4. *pp.* 136–138, *Sept.*, 1936.—The timer system described is particularly suitable for large student laboratories. It consists of a single tenth-second interrupter, driven by a synchronous motor, in a line to which all the timers are connected in parallel. Each timer has an electromagnet which advances a ratchet one notch each tenth-second and this in turn advances the hand through a train of gears. AUTHOR.

VACUA, HIGH.

***104. High-Vacuum Plunger Pump. T. Sone and Y. Moritomo.** *I.E.E., Japan, J.* 56. *pp.* 800–803, *July*, 1936. *English Abstract.*—An improved piston pump is described in which the effects of irregularities in the stroke are overcome by the constant addition of small quantities of oil. The pressure produced is slightly higher than the vapour pressure of the oil used and is suitable for plating by sputtering. H. G. C.

***105. Electromagnetic Piston Pump for Laboratory Use. W. Brenschede.** *Zeits. f. phys. Chem.* 178. *Abt.A.* 1. *pp.* 74–75, 1936.—A double-acting electromagnetic piston pump is described in detail, with illustrative diagram and efficiency curve, which is an improvement on a similar pump designed by R. Livingstone (*J. phys. Chem.* 33, *p.* 955, 1929) in that there is a thin air-cushion between piston and tube which almost entirely obviates friction, while the pump can work against pressures

exceeding 100 mm.Hg whereas Livingstone's pump can only operate against a water head of 5 mm. H. H. Ho.

*106. **High Vacuum-Manometer. P. Bonét-Maury.** *Comptes Rendus*, 203. *pp.* 839–841, *Nov.* 3, 1936.—Describes a modification of the Knudsen gauge. A glass cylinder, blown in pyrex, has two inner tubes, also of pyrex, which carry a foil, which is observed by a microscope. In use one of the inner tubes is filled with liquid air, so that the temperature difference between the two tubes is some 200° C. in which case the radiometer force on the foil is comparatively large, since it depends jointly on the temperature difference and the pressure of the gas. It is claimed that the gauge is stable and that the foil returns to zero when the temperature in the tubes is the same. G. E. B.

*107. **Laboratory Cements and Waxes. L. Walden.** *Journ. Sci. Instruments*. 13, *pp.* 345–352, *Nov.*, 1936.—Gives the principal properties, sources and uses of a large number of cements and waxes in laboratory practice. Some of the materials are suitable for vacuum work, while others are adapted for making joints impervious to water or oil. A useful table summarises the main properties of nine materials, giving at a glance their compositions, solvents, reactions with acids and alkalies, softening and melting points and other relevant notes. G. E. B.

108. Reactions in High Vacuum Melting. W. Kroll. *Zeits. f. Elektrochem.* 42. *pp.* 873–876, *Dec.*, 1936.—At decreasing pressures sublimation increases disproportionately, so that theoretically it is impossible to melt in high vacua, the heat supplied being used up in volatilisation of the metal. In practice no difficulty occurs, with few exceptions, *e.g.*, Cr and Mn. The volatility is not always that anticipated from the properties of the components. A balance is reached between gas removed by the pump or by condensation, and that generated, by dissociation, synthesis or degasification of the metal. Oxides show varying stability in high vacua. Reaction between C and oxides, either dissolved in the melt or even as stable refractories, is the most serious cause of vacuum degradation. Chemical reactions are affected, *e.g.*, Si, W, Ti, Al can reduce the volatile Ca, Sr, Ba, Li, and volatile acids (*e.g.*, boric) disappear. It may be advantageous to introduce a gas intentionally, *e.g.*, Cu and the alkaline earths are best melted in atmospheres of SO_2 and A at low pressures, respectively. Evaporation of refractories or heating elements (*e.g.*, C, SiO_2, W) may introduce impurities into the charge. D. R. H.

VISCOSITY, FRICTION AND LUBRICATION.

109. Viscosities of Gaseous Mixtures and their Representation by Kinetic Theory. E. Schröer. *Zeits. f. phys. Chem.* 34. *Abt.B.* 3–4. *pp.* 161–180, 1936.—The application of the formula $\eta_{12} = \eta_1 (1 + (n_2/n_1)A_1)^{-1} + \eta_2(1 + (n_1/n_2)A_2)^{-1}$ to determine the viscosity of the gaseous mixture (η_{12}) from that of its components (η_1 and η_2) is discussed, n_1 and n_2 being the molar fractions of the two gases and A_1 and A_2 expressions depending on their mass, molecular diameter and Sutherland's constant C. Most of the experimental data are in agreement with the theory. The discussion considers the value of the factor f in the expression $C_{12} = f(C_1C_2)^{\frac{1}{2}}$, and a value of about 0·95 is found to fit the data better than the lower value of 0·733 given by Jung and Schmick. Existing data are insufficient to show the effect of dipolar attractions. It can, however, be shown that for mixtures of dipolar gases there appears to be little dependence on temperature or pressure. R. W. P.

110. Movement of Fluids in Electrical Fields. P. Sokolow and S. Sosinski. *Acta Physicochimica*, 5. 3. *pp.* 433–450, 1936. *In German.*—A theoretical paper in which the Born equation is subjected to a close study. Various new equations are derived. The work of Dobinski, among others, is discussed. [See Abstract 3338 (1935).] J. K.

111. Heat Effects in Capillary Flow. M. D. Hersey. *Physics*, 7. *pp.* 403–407, *Nov.*, 1936.—Approximate mathematical solutions are given for the temperature distribution over the cross-section of a capillary tube under two extreme conditions, (1) complete adiabatic flow, and (2) thermal equilibrium. By complete adiabatic flow is meant an ideal condition in which there is no heat conduction although sufficient time has elapsed since the beginning of flow to permit any particle of the fluid to travel the entire length of the tube. By thermal equilibrium is meant, in the present connection, a steady state in which the heat due to viscous resistance is conducted radially outward as fast as it is generated. In each case the mean temperature rise at efflux is calculated by integration. In the case of thermal equilibrium, formulæ are also given for the decrease in apparent viscosity due to heat effects with increasing rate of flow.

AUTHORS.

112. Oiliness of Liquids. Part I. Static Friction Coefficients. J. Sameshima, M. Kidokoro and H. Akamatu. *Chem. Soc., Japan, Bull.* 11. *pp.* 659–666, *Oct.*, 1936.—The friction coefficients of certain chemical individuals were measured by Hardy and others, and their results have now been retested and their measurements extended to other substances with the object of finding relationships between oiliness and such other properties as the molecular constitutions of the liquids. Boundary lubrications have been measured both for the pure substances and mixtures, the static and kinetic coefficients of friction being obtained by several methods of which one, for the static coefficient, is now described with illustrations. Comprehensive data tables are included. H. H. Ho.

113. X-Ray Diffraction Studies of Lubricants. G. L. Clark, R. R. Sterrett and B. H. Lincoln. *Indust. and Engin. Chem.* 28. *pp.* 1318–1322, *Nov.*, 1936.—X-ray diffraction studies of thin solid films and of unimolecular films of organic compounds used as addition agents to mineral lubricants confirm that such additions give rise to oriented layers at metal surfaces. The degree of orientation (evidenced by the number of spectral orders observed) depends upon the nature of the metal. Chlorinated esters of the long-chain acid, short-chain alkyl type exhibit a specially high degree of orientation. The results are correlated with those of the customary Timken test. L. V. C.

See also Abstracts 50, 51, 52, 297.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***114. Optical Collimation Error in Meridian Observations. J. Procházka.** *Bull. Astronomique*, 9. 10. *pp.* 479–482, 1936.—It is pointed out that when the collimation error of a meridian telescope is determined by means of collimating telescopes to N. and to S. of the main instrument, trouble may arise due to optical defects in the collimators. Unless the rays emerging from these latter are exactly parallel and fill the whole aperture of the meridian telescope objective, physical differences between the image of the cross-wires and that of a star may render the optical axis indeterminate. It is shown that the errors involved can be estimated and eliminated by making the collimator objectives interchangeable and reversible, and taking twice the usual number of observations. The error of the Bouty meridian circle of the Paris Observatory is 0·0092 sec. of time, corresponding to 0·14 sec. of arc, a value far greater than the experimental error of setting. A. Hu.

See also Abstracts 102, 194.

COMETS AND METEORS.

115. Regularities in Spectra of Cometary Nuclei. J. Cabannes and J. Dufay. *Comptes Rendus*, 203. *pp.* 903–906, *Nov.* 9, 1936.—The most intense regions in cometary nuclei give radiations forming two groups near 4050 and 4300 Å respectively. Baldet has classified these for 26 comets between 1881 and 1925, and in these two groups the radiations correspond two by two. The authors investigate 29 out of Baldet's 36 radiations and have succeeded in identifying some, and conclude that every classification of cometary nucleus radiations should show the differences 1495 and 1815 cm.$^{-1}$. A. S. D. M.

116. Interstellar Meteors. C. Hoffmeister. *Preuss. Akad. Wiss. Berlin, Ber.* 18. *pp.* 195–229, 1936.—During the period March-May, 1933, 505 hourly meteor counts were made from a ship moving between latitudes 39° N. and 35° S. From diurnal variation curves, the mean heliocentric velocities of the non-cometary meteors are calculated for several latitudes. The values increase by some 50 % as the higher S. latitudes are approached. The standard hourly frequency is independent of latitude. It is suggested that the incident directions of travel are not uniformly distributed in space, a maximum density of starting-points existing in one region of the sky. A theory on these lines is shown to predict a sinusoidal annual variation both in the daily number and in the apparent heliocentric velocity of meteors, with a considerable phase difference between the two. Experimental support of the theory on these points is adduced, and it is concluded that a meteoric stream from Taurus passes through the solar system towards Scorpio or Libra. The possibility of a connection between such a stream and the dark nebulæ in these regions is discussed. A. Hu.

117. Spectroscopic Examination of Meteorites. A. S. King. *Mt. Wilson Observat. Contrib. No.* 556. *Astrophys. J.* 84. *pp.* 507–516, *Dec.*, 1936.—Spectrograms of the material from 13 meteorites, belonging to the Ni-Fe, stony, and graphite types, were examined, and 32 of the

constituent elements identified. Over half of these are not usually detected in chemical and mineralogical analyses of meteorites, some being among the rare terrestrial elements. Estimates of the abundance of the elements identified in iron and in stony meteorites, based on the degree of development of the spectra and the types of lines appearing, showed a fair agreement with the corresponding abundances found in chemical analyses by Noddack and Noddack. The distinctive differences in composition of iron and stony meteorites are discussed, also the evidence that elements abundant in the stony type may be disintegration products of those composing iron meteorites. The band spectra of meteoritic and of terrestrial graphites indicated no difference in the relative abundance of the C isotopes. AUTHOR.

COSMOGONY.

118. Limitations on the Behaviour of an Expanding Universe. J. L. Synge. *Roy. Soc. Canada, Trans.* 30. *Sect. III. pp.* 165–178, *May*, 1936.—The theory of the expanding universes of general relativity is studied under the restrictions that the pressure p, and density, ρ, of matter in the universe obey the inequalities, $p \geq o, \rho \geq o, p \leq \rho/3$. The possible developments are exhibited as curves in a phase-plane. For application of the result to the actual universe the observed value of the red-shift and of the average density of matter are required. G. C. McV.

See also Abstract 137.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

See Abstracts 124, 125.

LATITUDE AND LONGITUDE.

119. Variation of Latitude at Dehra Dūn. B. L. Gulatee. *Indian Acad. Sci., Proc.* 4*A. pp.* 383–403, *Oct.*, 1936.—The diurnal and Z-terms as deduced from the latitude observations at Dehra Dūn during 1930–33 are discussed. The Z-term has different amplitudes during each year and is explained satisfactorily by an empirical term of the form $a_2 \sin (2 \odot - \alpha - A_2)$. Its amplitude is so large, that it cannot be explained quantitatively by seasonal periodicity of the isopycnic surfaces. The closure errors of the chain during the three years, and some of the causes which produce them are discussed. The Dehra Dūn observations show no evidence of a relation between latitude variation and moon's age. AUTHOR.

NEBULÆ.

120. Photometry of Diffuse Nebula NGC 7023. P. C. Keenan. *Astrophys. J.* 84. *pp.* 600–608, *Dec.*, 1936.—The reflection nebula NGC 7023 was photographed in red and in blue light with the Perkins reflector. The photographic surface brightness is inversely proportional to the distance from the central star for radii of the order of 1′, but the curve is steeper for smaller radii. The observations do not fit any of the predicted curves computed on the assumption of uniform density, but indicate that there is a concentration of matter about the star, which probably lies a relatively short distance inside the nebula. The colour of some of the brighter parts of the nebula was compared with that of the star. For the larger part of the nebula the reflecting power is only slightly greater in red light than in blue, as would be expected if the particles are fairly large ; but there is a

well-defined portion in which a red excess of the order of 0·3 mag. was found. AUTHOR.

121. Polarisation in Reflection Nebulæ. L. G. Henyey. *Astrophys. J.* 84. *pp.* 609–618, *Dec.*, 1936.—Observations for the purpose of detecting the presence of polarisation in the light of the reflection nebula NGC 7023, the nebulæ in the Pleiades and the nebulous patches associated with γ Cygni have been made through a Polaroid screen used as an analyser. Each set of observations consisted of two plates having the principal plane of the Polaroid of one plate perpendicular to that of the other. The relative weakening or strengthening of the image along radii drawn from the star parallel to the positions of the principal plane of the Polaroid would indicate polarisation. Measurements on the plates of NGC 7023 indicate the presence of polarisation up to 12 %. The plates of the Pleiades and of γ Cygni indicate little or no polarisation. These results are shown to be compatible with the reflection theory of diffuse nebulæ, provided the reflecting particles are fairly large. In the case of the nebulæ around γ Cygni, the lack of evidence of polarisation does not favour the hypothesis of the presence of Rayleigh scattering in these objects. This hypothesis was suggested by the blue colour of these nebulosities. AUTHOR.

122. Effect of Red Shifts on the Distribution of Nebulæ. E. Hubble. *Mt. Wilson Observat., Contrib. No.* 557. *Astrophys. J.* 84. *pp.* 517–554, *Dec.*, 1936. *Nat. Acad. Sci., Proc.* 22. *pp.* 621–627, *Nov.*, 1936.—The distribution of spiral nebulæ between photographic magnitudes 18·47 and 21·03 is discussed, the data being taken from five surveys made with the 100-in. and 60-in. reflectors. The distribution is found to depart slightly from that corresponding to uniform distribution in depth and this departure is attributed entirely to the effect of the red-shift. Comparison with the theoretical predictions of the expanding universes of general relativity indicates a high positive curvature of space and a mean density of matter of the order of 10^{-26} gm./cm.^{3} as against the usually accepted order of 10^{-30} gm./cm.^{3}. The author is unwilling to admit that the observations indicate that the density of the spiral nebulæ increases outwards from the galaxy. He prefers to attribute the observed red-shift, not to velocity, but to some unexplained effect in the transmission of light over great distances. He shows that the apparent departures from uniform distribution observed could then be consistent with a real uniform distribution of stationary nebulæ in an Einstein universe. G. C. McV.

123. Classification Forms and Orientations of Extra-Galactic Nebulæ. A. Machiels. *Bull. Astronomique*, 9. 10. *pp.* 471–478, 1936. The author analyses the catalogues of the clusters, Eridanus-Fornax (928 ellipticals and 57 spirals) and Horologium (7695 ellipticals) and finds that (as in the Coma-Virgo clusters) there is a deficit of the less flattened nebulæ. He gives diagrams and concludes that this deficit is not real but is due to the mode of classification adopted ; it disappears when the classes are equal and their limits chosen judiciously. [See Abstract 3749 (1931).] He applies Hubble's method [see Abstract 1683 (1927)] and confirms his view [see Abstract 769 (1932)]. He deduces : (1) Elliptic nebulæ have no predominance in form over the others ; (2) spiral nebulæ are appreciably flat discs ; (3) the equatorial planes are oriented at random. A. S. D. M.

See also Abstract 137.

PLANETS.

124. Nearly Circular Motions under an Approximately Inverse-Square Law Attraction. J. Chazy. *Comptes Rendus*, 203. *pp.* 844–845, *Nov.* 3, 1936.—The author works out further details of his treatment of the problem of the motion of a particle in the gravitational field of a central body and of a ring of matter surrounding the latter. Circular motion, when the effect of the ring is small, is possible and the value of the osculating eccentricity of the orbit is found in this case. [See Abstract 5456 (1936).] G. C. McV.

125. Advance of the Perihelion and the Nodes of a Planet's Orbit under the Action of a Circular Ring. J. Chazy. *Comptes Rendus*, 203. *pp.* 981–982, *Nov.* 16, 1936.—In continuation of previous work [see Abstract 5456 (1936)] the advance of perihelion of the planet's orbit, as well as that of its nodes, is worked out. The agreement with the observed values for the solar system is fairly good. G. C. McV.

126. Shape and Size of Eros. W. Krug and G. Schrutka-Rechtenstamm. *Zeits. f. Astrophysik*, 13. 1. *pp.* 1–12, 1936.—An attempt is made to explain the light alternation of Eros on the assumption that the planetoid is a triaxial ellipsoid. The theory of illumination of such a body is developed from Lambert's law. The values of axial lengths, mass and density of the ellipsoid and the probable position of the pole which are in best accord with observation are derived. J. E. K.

STARS.

127. Absolute Magnitudes of Be Stars. H. Mineur. *Bull. Astronomique*, 9. 10. *pp.* 455–470, 1936.—A method is developed for determining the mean absolute magnitudes of the Be stars in the Merrill-Burwell catalogue, from their proper motions and radial velocities, where these are known. For this purpose the stars are statistically divided into 5 groups according to their spectral sub-types. Corrections are evaluated for applying to the absolute magnitudes given in 7 previously published catalogues of spectroscopic parallaxes. The final mean values obtained range between $-3{\cdot}8$ m. for B0e $-$ B1e stars and $-0{\cdot}8$ m. for B7e $-$ A0e stars. A comparison is made between the absolute magnitudes of Be stars and those of B stars. Russell-Hertzsprung diagrams, and curves showing the numerical distribution in the different absolute magnitudes, do not indicate any distinction between the two classes. It is concluded that Be stars include main sequence stars and supergiants in the same proportions as do ordinary B stars, but that in the mean the emission-line stars are $0{\cdot}3$ m. brighter. A. Hu.

128. Mean Parallaxes, Absolute Magnitudes and Distances of Groups of Stars. G. Strömberg. *Mt. Wilson Observat., Contrib. No.* 558. *Astrophys. J.* 84. *pp.* 555–567, *Dec.*, 1936.—Formulæ are derived in the computation of mean parallaxes, mean absolute magnitudes, and mean distances from the proper motions of stars, projected on the right ascension and declination axes, on the antapex direction and the perpendicular axes, and on the axis of galactic longitude. Formulæ for both the parallactic and the peculiar motions are derived from all the coordinate systems mentioned above. The general formulæ are given for the derivation of the mean errors in mean parallaxes. Formulæ for computing the dispersion in parallax, distance, and absolute magnitude are also derived. AUTHOR.

129. Spectrophotometric Investigation of the Cepheid S Sagitta. H. Brück and W. Strohmeier. *Zeits. f. Astrophysik*, 13. 1. *pp.* 13–24, 1936.—Monochromatic light curves at 8 selected wave-lengths from 4050 to 6300 Å are derived from photographs taken on panchromatic film of the Cepheid variable S Sagitta with a 30 cm. objective prism and mirror. From these curves colour indices, gradients and temperatures are determined and their variation with phase is investigated. The results are compared with those of other investigators. J. E. K.

130. Spectrophotometric Investigation of δ Cephei. W. Becker. *Zeits. f. Astrophysik*, 13. 1. *pp.* 69–86, 1936.—Intensity measurements obtained from 31 photographs of δ Cephei are communicated and show that the intensity distribution relative to ϵ Cephei can be represented by two gradients, one extending from 635 to 437 mμ and the other from 380 to 488 mμ with intersection at 478 mμ. The amplitude in the long-wave region is 75 % of that in the short-wave region. Comparison with ϵ Cephei permits the determination of colour temperatures and amplitude of δ Cephei. Three monochromatic light curves and colour index curves are deduced from the gradients. Correction of colour indices for absorption in the short-wave region reduces the amplitude to 75 % of that observed. The amplitudes deduced from the temperature variation by application of Planck's law exceed those observed by factors of 1·4 and 2·1 in the long- and short-wave regions respectively. J. E. K.

131. Unsymmetrical Broadening of Ca 4227 Å in dM Stars. K. Wurm and H. J. Meister. *Zeits. f. Astrophysik*, 13. 1. *pp.* 25–35, 1936.—In the spectra of dwarf M stars, the resonance line λ4227 of Ca is unsymmetrically broadened, the absorption extending from λ4150 to λ4650. An explanation of this effect is sought. Ca is vaporised in an atmosphere of H_2 or of A and its absorption spectrum examined in the temperature range 1000–2200° K. The broadening which occurs, though unsymmetrical, is not identical with that appearing in dM spectra, and at stellar temperatures a secondary maximum at λ4550 causes a further dissimilarity. Lindblad's suggestion that the effect is due to weakly-bound Ca_2 quasi-molecules is reviewed, but rejected on the ground that no detailed agreement with experiment is found. It is suggested that as the red system of CaH appears strongly in dM spectra, the long-wave end of the absorption may be due to the (1,0) band of the *D* system of this molecule at λ4235. The violet wing must, however, be attributed to some other molecule. A. Hu.

132. Spectrographic Study of φ Persei. H. F. Schiefer. *Astrophys. J.* 84. *pp.* 568–584, *Dec.*, 1936.—The variations in the hydrogen lines of the spectrum (class B0pe) of φ Persei are described. Each line consists of a broad absorption, on which is superposed a narrower emission divided by a sharp central absorption. The radial velocity calculated from this latter shows cyclic variations in a period of 126·6 days. Similar variations are shown by the intensities of the absorption and of the emission components ; by the relative intensities of the emission components ; and by the intensity of the central absorption relative to the continuum intensity. The total emission width and the widths of the separate components vary in one-half the star's velocity period. The effects are ascribed to the orbital motion and rapid axial rotation of 2 stars, each with an extensive atmosphere. The emission originates in the projecting parts of both atmospheres, the absorption in the outer atmosphere between the observer

and the photosphere of the primary star. Secondary variations are described and attributed to a complicated pulsation mechanism. A. Hu.

133. Stellar Temperature Scale. A. Pannekoek. *Astrophys. J.* 84. *pp.* 481–506, *Dec.*, 1936.—The methods of determining stellar temperatures from colour and energy distribution, from ionisation, and from the Boltzmann function are discussed and are shown to depend upon complicated conditions in the atmospheres of the stars which are not sufficiently known at the present time to permit the derivation of reliable temperatures. Direct methods of determining the effective temperatures of stars give 3300° for class cM0 and 10,500° for class A0. These values are regarded as well established, their uncertainty being estimated at no more than 5 %. It is suggested that from the degree of accordance between these temperatures and those obtained by other indirect methods information may be obtained concerning the conditions prevailing in the atmosphere of the stars. Author.

134. Temperatures of Stars Surrounded by Gaseous Envelopes. S. G. Gordeladse. *Zeits. f. Astrophysik*, 13. 1. *pp.* 48–55, 1936.—The mechanism of bright-line emission from the gaseous shells of relatively small extent which surround Be and Wolf-Rayet stars, Novæ, etc. is examined. It is assumed that the physical similarity between such stars and planetary nebulæ extends to the mechanism of absorption in the gaseous envelopes which is envisaged in Zanstra's theory of nebular luminosity; the difference being that the dilution factor is much larger for bright-line stars than for planetary nebulae. In this case cyclic electronic transitions $2\rightarrow n\rightarrow(n-1)\rightarrow\ldots\rightarrow 3\rightarrow 2$ may occur as well as the planetary nebula type $1\rightarrow n\rightarrow(n-1)\rightarrow\ldots\rightarrow 2\rightarrow 1$. Thus stellar radiation beyond the limit of the diffuse (*e.g.*, Balmer) series, as well as that beyond the principal (*e.g.*, Lyman) limit, plays a part in the formation of emission lines. Thence the Zanstra method is applied, and the optical depth at the frequency $\nu_{1\rightarrow 3}$ calculated as a function of the temperature and ionisation potential of the gaseous material. Numerical results are given for temperatures from 10,000 to 30,000°K., and for ionisation potentials corresponding to H and He atoms and to He ions. A. Hu.

135. Radiation Flux in Stellar Atmospheres. G. Burkhardt. *Zeits. f. Astrophysik*, 13. 1. *pp.* 56–68, 1936.—Approximate expressions, given by Unsöld and Maue and by Eddington, for the radiation flux F_ν at frequency ν in a stellar atmosphere in radiative equilibrium, are reviewed and found convenient but inaccurate. Starting from Eddington's solution of the Schwarzschild-Milne integral equation, the author uses a series of numerical integrations to construct a table showing the variation of F_ν with $h\nu/kT$ and with κ/κ_ν, where κ is the Rosseland mean value of κ_ν, the continuous absorption coefficient at frequency ν. κ/κ_ν is assumed independent of depth. Curves show that the linear approximation of Unsöld and Maue breaks down when $h\nu/kT>6$, especially if κ/κ_ν is large. The intensity discontinuities at the Balmer and Paschen limits are derived from the calculations. They are in better agreement with experimental values than are those found from the linear approximation. The position and numerical value of maximum absorption in the Balmer and Paschen series, as found from the calculations, agree satisfactorily with observations on early-type stars. A. Hu.

136. Stellar Atmospheres. A. Unsöld. *Zeits. f. techn. Physik*, 17. 11. *pp.* 366–371, 1936. *Phys. Zeits.* 37. *pp.* 792–797, *Dec.* 1, 1936.—The information which is derived from the positions, relative intensities

and line-profiles of the lines and other features of stellar spectra is popularly expounded. The physical characteristics of the stellar atmospheres producing the spectra are discussed and it is also shown how a value for the velocity of rotation of a star can be deduced from an examination of the shapes of its spectral lines. G. C. McV.

137. Structure of the Universe. P. ten Bruggencate. *Zeits. f. techn. Physik*, 17. 11. *pp.* 354–359, 1936. *Phys. Zeits.* 37. *pp.* 780–785, *Dec.* 1, 1936.—A popular account is given of the structure of the galaxy and of the methods by which this structure is deduced. The system of the spiral nebulæ is then similarly discussed. G. C. McV.

138. Distribution and Nature of the Dark Matter in Space. E. Schoenberg. *Zeits. f. techn. Physik*, 17. 11. *pp.* 359–365, 1936. *Phys. Zeits.* 37. *pp.* 785–791, *Dec.* 1, 1936.—A popular account of the present state of knowledge of the dark clouds of matter in the galaxy is given. Counts of spiral nebulæ as well as the comparison of the colour indices and luminosities of galactic stars yield important information as to the density and position of the clouds. The clouds consist of fine particles at rest relative to the galaxy as a whole and therefore sharing in its rotation. G. C. McV.

139. Scorpio-Centaurus Moving Cluster. C. Bertaud. *Bull. Astronomique*, 9. 10. *pp.* 483–512, 1936.—The material used consists of all the H.D.C. stars, 4520 in number, which satisfy the following conditions: magnitude $\leqslant 8$; spectral type O to A3; R.A. 8h. to 20h.; declination $-10°$ to $-80°$. The distribution in R.A. is plotted, and shows, especially for the B-stars, 3 concentrations; in declination, the B-stars tend to concentrate near the Milky Way. The mean proper motions of 1332 of the stars are studied as a function of R.A. and compared with the parallactic motion. Thence it is concluded that between R.A. 9h. and 17h. in the zone $-10°$ to $-80°$ declination, most of the B- and A-stars, particularly the former, are moving in a cluster towards an apex, determined from 239 stars, at R.A. 6h. 27m. $\pm$ 4m., declination $-40{\cdot}3° \pm 4{\cdot}7°$. The streaming velocity is found, from 66 stars of constant radial velocity, to be $18{\cdot}4 \pm 1{\cdot}6$ km./sec. A table gives the proper motions, parallaxes, and absolute magnitudes of 286 of the stars in the cluster. The 8 Be-stars included are in the mean 0·4 magnitudes brighter than the B-stars of the same spectral sub-type. A. Hu.

140. New Binary of Large Parallax. G. P. Kuiper. *Astrophys. J.* 84. *pp.* 478–480, *Nov.*, 1936.—The M-type dwarf 17 Lyrae C ($19^h3{\cdot}6^m$, $+32°\ 21'$) was seen (1936·80) as a double star in the Yerkes 40-in. Its elements are: p.m. $= 1''{\cdot}66$ in 49°; parallax $= 0''{\cdot}123 \pm ''{\cdot}006$; separations less than 3 a.u.; period about 5 years; components, apparent photo-visual magnitudes, 11·73 and 12·1, absolute magnitudes 12·2 and 12·6. Since its $\triangle m = 0^M4$ and its parallax is large, this star will in time afford a new absolute mass determination. A table is given of 12 near M dwarf binaries fainter than absolute magnitude 10·0. A. S. D. M.

141. Deceleration of Expanding Shells around Novæ. F. J. M. Stratton. *Observatory*, 59. *pp.* 325–331, *Nov.*, 1936.—The author examines the theory that the steady decrease of radial velocity found for the first expanding shell round Nova Herculis 1934 is due to the gravitational attraction of the central star. The velocity-epoch curve observed for H is distinct from that of the other elements. Neither form fits at all well the requirements of the theory. The values obtained for the effective mass of the central star, as reduced by the increasing radiation pressure, decrease with time, as expected, but are much lower for Fe^+ than for H;

for H, indeed, they appear impossibly high. The explanation is therefore abandoned and others are discussed. The simplest solution appears to be that the medium through which the expansion takes place is so viscous that the effects of gravity and of a varying radiation pressure are outweighed. This hypothesis is however not without its disadvantages, and the complexity of the problem is emphasised. A. Hu.

142. Anomalous Absorption Effect in Nova Herculis 1934. E. G. Williams. *Observatory*, 59. *pp.* 331–334, *Nov.*, 1936.—The spectrum of the Nova in its early stages consisted as usual of broad undisplaced emission bands, assumed to originate in expanding shells of radiating gas, flanked on their violet sides by absorption bands due to ejected matter moving radially towards the observer. By assuming spherical symmetry and reflecting the contour of the red half of an emission band on to the violet side, about the position of zero velocity, it is possible to find the intrinsic shape of the absorption component. When this is done, the absorption line appears to be deeper than the continuous spectrum from which it is absorbing. This apparently impossible result is regarded as an indication that symmetry does not exist in the emission band. It is pointed out that although a model invoking self-absorption in the expanding envelopes would leave the violet half weaker than the red, it will not explain the existence of complete blackness in the absorption bands. A. Hu.

143. Nebular Spectrum of Nova Herculis 1934. J. Dufay and M. Bloch. *Zeits. f. Astrophysik*, 13. 1. *pp.* 36–47, 1936. *In French.*—Between June 1935 and July 1936, 61 objective-prism spectrograms of the Nova were obtained. The spectrum throughout is of the nebular type associated with the later stages of the evolution of Novæ. Wavelengths, mean intensities, and identifications are tabulated for 116 lines. The possibility that λ5304, hitherto identified with the coronal green line, should be assigned to [CaV] is discussed. The variations in relative intensity of certain selected lines are traced throughout the period. The marked resemblance between the spectrum and that of a planetary nebula extends not only to the forbidden lines of O I, O II, O III, N II, Ne III, and A IV, but also to some of the fainter permitted lines of O III and N III. Bowen's prediction [see Abstract 625 (1935)] of the appearance of these latter in Novæ as well as in planetary nebulæ is verified. A. Hu.

See also Abstracts 219, 368.

SUN.

144. Intensities of Blended Absorption Lines. A. D. Thackeray. *Mt. Wilson Observat., Contrib. No.* 555. *Astrophys. J.* 84. *pp.* 433–461, *Nov.*, 1936.—The intensities of 14 absorption lines of the solar spectrum which lie in the wings of the H and K lines are measured at the centre and disc of the sun and over a sunspot. The intensities of these blended lines show progressive weakening as the blending increases and are roughly proportional to the intensity within the neighbouring Ca wing. The central intensities are constant irrespective of the blending; Rowland intensities depend primarily on the core intensity. Eddington's theory of the formation of absorption lines is developed and found to give a weakening which agrees well with observations. Severely blended lines, particularly Fe 3969 show an excess weakening which may be explained as due mainly to the effect of collisions and electron captures and in part to interlocking. J. E. K.

See also Abstracts 154, 158, 399.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

145. Influence of Contents of Bore-Hole on Apparent Specific Resistance. J. N. Hummel and O. Rülke. *Beitr. z. angew. Geophys.* 6. 3. *pp.* 265–270, 1936.—The contents of the bore-hole in general have a different specific resistance from that of the rock. The apparent specific resistance of this filling is found mathematically to differ considerably from that of the rock for small distances between the electrode and the nearer probe in extensive strata, but for a distance about 10 times the diameter of the bore-hole the difference is negligible. [See also Abstracts 4090 and 5051 (1936).] H. M. B.

146. Propagation of H.F. Fields in Mountains. V. Fritsch. *Beitr. z. angew. Geophys.* 6. 3. *pp.* 277–306, 1936.—If a h.f. receiver is placed in a hole inside a mountain, then the waves have three paths by which they may reach this point, along the surface of the ground, through the rocks and through any fissures. The effect of minerals and water bearing strata and also the atmospheric conditions affecting the surface soil are reviewed from the theoretical side and additional theory given. Experiments show that while qualitative conclusions can be drawn, a closer study of the conductivity of rocks is required before quantitative results can be made. It is noted that the h.f. waves may be used in mines for wireless communications if the ordinary telegraph is not functioning, also the presence of mineral deposits can be located and their nature ascertained by the absorption they cause. [See also Abstracts 1119 and 4091 (1936).] H. M. B.

147. Fundamental Principle of Applied Geophysics. H. Löwy. *Beitr. z. angew. Geophys.* 6. 3. *pp.* 271–276, 1936.—The indispensability of a knowledge of the geology of the region in interpreting the data supplied by the magnetic, seismic and gravity methods of geophysical prospecting is stressed. It is then shown that the electrodynamic method can give reliable indications of the presence of ore, oil or water, at least in an arid region, without such knowledge. C. A. S.

LAND, PHYSICS OF THE.

See Abstracts 145, 146, 281.

METEOROLOGY.

148. Oscillations of the Atmosphere. H. Jeffreys, with a note by G. I. Taylor. *Roy. Soc., Proc.* 157*A*. *pp.* 535–537, *Dec.* 2, 1936.—In a recent paper [see Abstract 4108 (1936)] Taylor has shown that for any distribution of temperature with height in the atmosphere there are in general an infinite number of possible velocities at which long waves can travel, and an infinite number of equivalent depths H. In the special case of convective equilibrium there is only one. A formula for H as an integral of a function of the temperature over the height of the atmosphere, given by Jeffreys [*Roy. Meteorolog. Soc., J.* 52. *pp.* 85–88, 1926], is criticised by Taylor on the grounds that if such a formula were possible, there would be only one possible velocity of long waves in the atmosphere. Jeffreys here explains that this interpretation is due to a misunderstanding, since

he was concerned to find the periodic winds associated with a *given* periodic variation of temperature (or of virtual temperature—a modification of the temperature to allow for the effect of humidity). The motions can then be compared with the forced oscillations of an ocean of the depth H. Free oscillations could be found in this way by taking the supposed given temperature variation to be zero ; but then the temperature must be assumed not to change at any point during the motion, heat being added to or subtracted from each element so that it always has exactly the same temperature as the original temperature at its new position at any time. Taylor adopts the adiabatic equation of state ; the implied condition required for the application of Jeffreys's integral to free oscillations is not, in general, satisfied in that, or in any other obvious case. A specific mathematical criticism by Taylor is also replied to, and a correction by Coulson referred to. In a note, Taylor agrees that the difficulty is cleared up as regards Jeffreys's paper, mentions that the use of integrals for the equivalent depth has elsewhere been considered legitimate, and stresses that no such integral representations can, in fact, be valid. S. G.

149. Daily Temperature Period for Linear Variation of Exchange Coefficient. B. Haurwitz. *Roy. Soc. Canada, Trans.* 30. *Sect. III. pp.* 1–12, *May*, 1936.—The paper gives a method which allows the determination of the variable exchange (*austausch*) within the layers where observation shows a linear increase of the eddy viscosity. The coefficient A/ρ is assumed to be a linear function of the height. A solution giving the daily temperature wave is first given for constant exchange coefficient. Curves are drawn for amplitude and phase retardation of the wave using both constant and variable values of the coefficient. A table of the daily temperature wave for $A/\rho = (8 \times 10^3 + 7{\cdot}2\,z)$ is also given. These show that the amplitude decreases first rapidly with elevation then slowly, while phase retardation increases rapidly at first and then becomes more linear. For a determination of the daily temperature period the author considers the retardation of the maximum at two levels. Arbitrary values for $y_o = 2\sqrt{V(k_o + \lambda z)}/\lambda$ can be chosen and so a, a function of y, can be found. The retardation enables corresponding quantities at different levels to be determined. Finally A is obtained. The values of A are greater than those found with constant coefficient. A. E. M. G.

***150. Dynamics of Rain Showers. G. A. Suckstorff.** *Göttingen Nachrichten, Fachgruppe II.* 2. 2. *pp.* 9–49, 1936.—A description of the instruments used to measure the changes in the meteorological elements during the passage of a shower is given. These instruments are made with as little inertia as possible. A number of showers occurring on given dates in 1935 are investigated. For this purpose the general weather situation on each of the dates is discussed. As a shower cloud passes it is found that a quick temperature fall occurs in the first third of the cloud and a slower temperature rise behind the cloud, independent of the sun's radiation. This temperature variation is attributed to a vertical motion of the air which is probably composed of a closed circulating system within the shower cloud and consisting of two whirls with horizontal axes. It may be shown also that this circulation first found in the normal rain shower probably exists in every strongly developed cumulus. The paper is illustrated by diagrams and reproductions of records. A. E. M. G.

151. Sodium Chloride Content of Air. H. P. Godard and W. F. Seyer. *Roy. Soc. Canada, Trans.* 30. *Sect. III. pp.* 85–88, *May*, 1936.—A description is given of the method of filtering the air, and of estimating

the amount of chloride content. The filtering apparatus is shown by diagram. The observations were carried out on the coast line opposite Vancouver Island with winds from all different directions. The authors find no relation between wind direction and salt content, but cold clear days and days of high relative humidity show also high salt content. They consider the method suitable for observations made over the sea or close to the sea shore. A. E. M. G.

152. Evaporating Power of the Air and Humidity of the Soil. H. Geslin. *Comptes Rendus*, 203. *pp.* 1095–1097, *Nov.* 23, 1936.—The connection between the experimental evaporation from the soil E_s, the evaporating power of the air E and the humidity of the soil H is given by $E/E_s = F(H)$. From the experimentally determined values of E, E_s and H for a clay soil a curve is drawn. This enables the relationship to be established. For a humid soil E/E_s gives the value 0·6. This value increases rapidly with diminution of H. From an investigation extending over the period 1932-1936 the author finds that the calculated humidities correspond well with the observed values: also that a soil humidity of 25 % on the scale adopted characterises the capacity of the soil for retention of precipitation. The author considers therefore that the investigation provides a simple method of knowing at each instant from ordinary climatological data the reserves of water in a soil, and of determining the fluctuations of these reserves with time. A. E. M. G.

153. New Index Representing Dryness Factor in Agriculture. J. Servy. *Comptes Rendus*, 203. *pp.* 1097–1100, *Nov.* 23, 1936.—In previous work [see Abstract 1534 (1935)] simple formulae based on the ratio P/E (rain/evaporation) were sought for as characterising the dryness factor. Now the index $R = \Sigma(P)/\Sigma(E)$ taken over a period tends towards a constant. To avoid this a new index is devised. This new factor R is such that the influence of any given month decreases with time so that the effect of that particular month is soon negligible. The relation between R and the humidity H of the soil is then considered and a graph drawn for the years 1932-1936. An expression of the form $R = aH^m$ is deduced. From the investigation the author concludes that to each type of soil there is therefore a relation $R = aH^m$ characterising its real ability to retain water, *i.e.*, to maintain its reserves in given climatic conditions. A. E. M. G.

154. Solar Climate. A. Puppo. *Ricerca Scientifica*, 2. *pp.* 391–399, *Oct.*, 1936.—In actinometric research there are five elements into which the subject may be divided, direct sunlight, diffuse radiation, global radiation, albedo and nocturnal radiation. The various pyrheliometers and actinometers in use are reviewed, and the point is made that a definite standard of radiation is necessary; in Italy, the Upsala scale has been adopted as the standard. The method of using instruments employing known filters for the visible and infra-red region of the spectrum is discussed and stress is laid upon the cadmium photo-cell, which is used from 3200–2800 Å, the region of the ultra-violet, which is of most interest biologically. H. M. B.

***155. Receiver for Radio Meteorographs. A. V. Astin and L. L. Stockmann.** *Rev. Sci. Instruments*, 7. *pp.* 462–463, *Dec.*, 1936.—A receiver for use in radio meteorography is described. It is one which has given satisfactory performance in this field for about one year. It is based on the Jones 5-metre superheterodyne receiver. Designed for the reception of pulse-type signals it has a low response to random noises. AUTHORS.

See also Abstracts 158, 281.

SEISMOLOGY.

156. Long Waves and Focal Depth. C. Bois. *Comptes Rendus*, 203. *pp.* 948–949, *Nov.* 9, 1936.—The examination of a number of earthquake records leads to the conclusion that it is necessary to abandon the criterion of abnormal focal depth based on the relative importance of long waves and preliminary phases. W. A. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

157. General Flow of Ion-Current in Earth's Atmosphere. K. Terada. *Geophys. Mag., Tokyo*, 10. *pp.* 275–308, *Sept.*, 1936. *In English.*—Part I of the paper is devoted to a theoretical treatment of the subject. An expression for the space charge is derived, Poisson's equation solved and a general formula found which expresses the ion-current. As special cases the author investigates the ion-current (1) in an atmosphere at rest, (2) when the temperature is maximum at the north (or south) pole and minimum at south (or north) pole. Such a case he considers useful when dealing with seasonal variation; and (3) when the temperature distribution is symmetrical with respect to the equator. Part II deals with numerical calculations. As regards temperature it is shown that a knowledge of the value of the surface temperature is sufficient to enable one to calculate the ion current. The parts played by conduction and correction processes are then treated separately. A comparison of these is difficult as the numerical value of the coefficient of viscosity is not known. The vertical current which arises mainly from the conduction process is considered by the author to be rather greater, however, than the horizontal current due to the transport of charge by the wind.

A. E. M. G.

158. Terrestrial Magnetic Phenomena and the Emission of Electrons by the Sun. D. Barbier. *Comptes Rendus*, 203. *pp.* 920–922, *Nov.* 9, 1936.—An attempt is made to explain terrestrial magnetic storms and the excitation of auroræ on a simple theory of electron emission from the sun, without using any arbitrary hypotheses. The thermal velocity of electrons at the sun's surface is shown to be of the same order as the velocity of escape there. A positive charge will therefore result from dissipation of electrons. The electric field thus set up will retain nearly all the remainder of the electrons whilst still relatively small. Near an active spot presented to the earth, irregularities in the field allow the escape of some of the faster electrons, which are decelerated to some 1000 km./sec. by the field, travel to the earth in the 60 hr. needed to explain the time-lag of the associated magnetic storm, and are there accelerated by a terrestrial positive charge, whose origin is discussed, to the 60,000 km./sec. which allows them to excite the auroral spectrum. A. Hu.

RADIOACTIVITY.

159. Concentration of RaA and Other Products of Short Decay: Discussion of Gerdien's Method. G. Aliverti. *Accad. Sci. Torino, Atti*, 71. *Disp.* 3*a*. *pp.* 432–442, *May–Oct.*, 1936.—Experiments are described for the concentration of RaA by collection on a positively charged collector. The results show that (1) Gerdien's method applied to filtered air gives only a small yield, (2) the effluvium method results in an excellent yield. With unfiltered air, in agreement with Rosa's results, it is found that Gerdien's method results in concentration of RaA + RaB + RaC though the yield is only moderate. F. C. C.

160. Columnar Ionisation. W. R. Kanne and J. A. Bearden. *Phys. Rev.* 50. *pp.* 935–938, *Nov.* 15, 1936.—The ionisation collected from single α-particles is measured as a function of the angle between the path of the particle and the direction of the electric field. Data obtained for electric field strengths of 8, 100 and 500 V/cm. and for air pressures of 1 and 2 atm. are given. These results are compared with curves based on the theory given by Jaffé. The agreement between theory and experiment is satisfactory and shows clearly that for low field strengths the loss of ions by recombination is appreciable even for large angles between particle path and electric field. In contrast with values of the recombination coefficient given by Jaffé, it is indicated in the present work that previously accepted values for this quantity are correct. A description of the FP-54 Pliotron circuit which has been used for this work is given. AUTHORS.

161. Nuclear Radius and Many-Body Problem. H. A. Bethe. *Phys. Rev.* 50. *pp.* 977–979, *Dec.* 1, 1936.—The radioactive α-decay is discussed as a many-body problem. The nuclear radius is found to be 13×10^{-13} c.m $\pm$ 10 %, as compared to 9×10^{-13} in the older theory. The increased radius makes the theoretical cross-section for the disintegration of heavy nuclei by deuterons agree with experiment. AUTHOR.

162. Conservation of Energy and Shankland's Experiment. F. Cernuschi. *Comptes Rendus*, 203. *pp.* 777–779, *Oct.* 26, 1936.—Starting from the hypothesis of excitation states of electrons, an explanation of the Shankland experiment [see Abstract 1241 (1936)] is given which is in accordance with the conservation of energy. C. B. A.

See also Abstracts 10, 11, 12, 328, 329, 330, 331, 332, 400.

RADIATION.

ABSORPTION AND TRANSMISSION.

***163. Infra-Red Transmissions of Powder Films. J. H. Plummer.** *J.O.S.A.* 26. *pp.* 434–438, *Dec.*, 1936.—With a view to finding filters for the region about 130 μ, powder films were tested for transmission using a wire-grating spectrometer. As the performance is better with particles of uniform size, the method of separation by dispersion in a liquid is described, while for particles larger than 67 μ sieves were employed. Powders of quartz eliminate the band 40 μ to 80 μ and form almost perfect filters between 6·5 μ and 7·9 μ. Filters made by fuming MgO or distilling selenium are most practical between 0·5 μ and 10 μ and powders of NaCl and KBr between 10 μ and 40 μ. F. S.

***164. Infra-Red Filters. R. B. Barnes and L. G. Bonner.** *J.O.S.A.* 26. *pp.* 428–433, *Dec.*, 1936.—A simple filtering system, involving the use of only two simply constructed Se powder filters, is described, by the use of which it is possible to obtain a pure energy spectrum with a wire grating spectrometer in the region 40–130 μ. In addition transmission curves are given for a number of substances in the regions 1–15 μ and 35–130 μ. AUTHORS.

See also Abstract 212.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

165. Electrical Birefringence of Liquid Oxygen and Nitrogen. R. Guillien. *K. Onnes Lab. Leiden, Comm. No.* 242*d*. *Physica*, 3. *pp.* 895–903, *Nov.*, 1936. *In French.*—The electrical double refraction of liquid O_2 and N_2 was measured at different temperatures with reference to the green ray of Hg. The values obtained are compared with the values given by Langevin's theory, starting with the factor of depolarisation of light diffused by N_2 and O_2 in the gaseous state. The values found by experiment are lower than the theoretical values. The observed thermic variation of Kerr's constant is for O_2 more rapid and for N_2 less rapid than the calculated variation. A description is given of the method and of the apparatus. The method is that of Chauvin for the measurement of Kerr's constant. [See following Abstract.] J. J. S.

166. Electric Birefringence of Mixtures of Liquid Oxygen and Nitrogen. W. H. Keesom and R. Guillien. *K. Onnes Lab. Leiden, Comm. No.* 242*e*. *Physica*, 3. *pp.* 939–946, *Nov.*, 1936. *In French.*—The magnetic susceptibility of mixtures of liquid O_2 and N_2 has been measured by Perrier and Kamerlingh Onnes who have proved that the specific susceptibility of O_2 increases by dilution. They have interpreted this phenomenon as a Weiss molecular field. Lewis considers it to be due to the dissociation of a polymer O_4 of oxygen. From measurements of the magnetic susceptibility of gaseous O_2 Wiersma and Gorter arrive at results agreeing with the calculations of Lewis. The absorption spectrum of O_2 in the gaseous state or the liquid on examination points to the existence of double molecules. Lainé recently has found a considerable increase of the specific birefringence when N_2 is diluted. The present paper describes further studies. Kerr's constant B of mixtures of liquefied O_2 and N_2 was measured for the green ray (λ 5461) of Hg from 78°·15 K.

to 65° K. The experimental curves giving B as a function of the composition at constant temperature are a little below the curves deduced from Langevin's theory. Attributing this behaviour to the diminution of the specific birefringence of O_2, the birefringence per gm.mol. is calculated for O_2 infinitely diluted. [See preceding Abstract.] J. J. S.

167. Influence of Substituents on the Kerr Effect in Nitrobenzene. O. Hilke. *Zeits. f. Physik*, 103. 5–6. *pp.* 350–394, 1936.—The measurements are made with a Kerr cell of only 1 cm. optical path, the necessary sensitivity being obtained by using a Babinet compensator. This also allowed the uniformity of the electric field between the plates which gives an indication of the conductivity, to be observed. A process for the purification of nitro-benzene is described with the aid of which the conductivity can be reduced to 6×10^{-10}. The conductivity remains at this low value for three weeks, if the condenser plates are made of Ni, or nickel-plated. In each series of measurements the conductivity decreases with time, owing to electrolytic purification. Finally the Kerr constant for pure nitro-benzene was found to be $3{\cdot}94 \times 10^{-5}$. Then various amounts of numerous other substances were added after finding the way in which these had to be purified in order to keep the conductivity low. The Kerr constants of these mixtures were measured and did not vary linearly with concentration. This fact is discussed. The dielectric constant of nitrobenzene is constant for frequencies below 4×10^5 but decreases for higher frequencies. It becomes constant again at frequencies of about 10^7 sec^{-1}. The Kerr constant is proportional to the inverse fourth power of the temperature. This fact is hard to interpret. R. P.

168. Researches Utilising the Magneto-Optical Kerr Effect. C. Zapf. *Ann. d. Physik*, 27. 6. *pp.* 477–506, *Nov.*, 1936.—Measurements of the Kerr rotation by mirrors cut from natural magnetite crystals (normal magnetisation of mirror and normal incident light) show a relation between the Kerr constant and the crystallographic orientation of the mirror face ; this seems remarkable because magnetite is a cubic crystal. The relations between the Kerr effect and the wave-length of the incident light (red and near infra-red) and the intensity of magnetisation of the mirror are given. Corresponding measurements of Fe crystals on the surface of rolled foil give no definite result. Using strained Fe and Ni specimens, it is shown that there is no conclusive magneto-optical proof of the presence of strain on the surface. H. J. H. S.

169. Magnetic Rotatory Polarisation and Magnetic Double Refraction of Solutions of β-Naphthol and β-Methylnaphthalene. J. Rabinovitch. *Comptes Rendus*, 203. *pp.* 991–994, *Nov.* 13, 1936.—For β-naphthol dissolved in acetone the magnetic rotatory polarisation and magnetic double refraction were found to be linearly related to the concentration. For β-methylnaphthalene dissolved in CCl_4, however, anomalies were observed which are attributed to a partial transformation of the β- into α-naphthalene. This suggestion leads to a quantitative interpretation of the observations. **Errata.** *ibid. p.* 1556, *Dec.* 28, 1936. W. S. S.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

170. Optical Properties of Fuchsin in Polarised Light. F. Hlučka. *Zeits. f. Physik*, 103. 3–4. *pp.* 246–249, 1936.—The optical constants n and k for fuchsin in polarised light in the spectral region 740 to 404$\mu\mu$ are determined. The experimentally determined values of

reflection are also compared with the values calculated from the n, k, values. Good agreement is obtained. J. E.

171. Sensitising of Phosphors. Part II. S. Rothschild. *Phys. Zeits.* 37. *pp.* 757–763, *Nov.* 1, 1936.—In a previous paper the author showed that the phosphorescence of Sm-activated phosphors was intensified by the addition of Bi [see Abstract 4149 (1934)] and that the phosphor was excited by visible light in the presence of Bi but only by u. v. light in the absence of Bi. This work is an extension of these results. It is now found that Bi does not affect Pr phosphors. A number of other cases of apparent intensification by addition of a second metal as impurity are given in a table. Some general remarks are made about phosphorescence and fluorescence. J. E.

172. Visible Fluorescence of Mercury Vapour. A. Kastler. *Ann. de Physique,* 6. *pp.* 663–750, *Nov.*, 1936.—The visible fluorescence of Hg vapour (emission of 4046, 4358 and 5461 Å) is due to a double excitation in echelon, the exciting radiations being 2537 and 4538 Å. The author has calculated the intensities and polarisation of the fluorescence, assuming the coherence of the two steps of excitation. The theoretical conclusions are : (1) The degree of polarisation of the pure vapour must be of opposite sign to that in the presence of N_2. (2) The degree of depolarisation under pressure or in a magnetic field for pure Hg proceeds more rapidly than in the presence of N_2. (3) The coherence between the two steps of excitation should give optical selection between the odd and even isotopes, using polarised excitation. The experimental study of the intensity and degree of polarisation consisted of : (1) Investigations with and without N_2 and (2) study of thermal and magnetic depolarisation of pure Hg, using ordinary light; and (1) Comparison of π and σ excitation, (2) comparison of intensities of circular vibrations of the same and of opposite sense to exciting light, using polarised light. The agreement between the experimental and theoretical results is satisfactory. J. E.

See also Abstracts 217, 265, 268, 269.

INTERFERENCE, DIFFRACTION AND SCATTERING.

173. New Optical Diffraction Phenomena in Solid Oscillating Bodies. L. Bergmann. *Zeits. f. techn. Physik,* 17. 11. *pp.* 441–443, 1936. *Phys. Zeits.* 37. *pp.* 867–869, *Dec.* 1, 1936.—Diffraction effects are shown in cubes of various crystals, such as quartz and calcspar cut in different directions to the optic axis when in a state of h.f. oscillation, and when light passes through the crystal. The optical arrangement is given for reflection from certain solids, this method is applied to glass and quartz and the diffraction photographs so obtained are reproduced. It is proposed to use reflections for bodies which are opaque to light or in which optical heterogeneity is small. Circular diffraction patterns are obtained for glass and more varied patterns for quartz and calcspar. [See also Abstract 3695 (1935).] H. M. B.

174. Diffusion of Light by Neutrons. J. Solomon. *Comptes Rendus,* 203. *pp.* 926–928, *Nov.* 9, 1936.—A consideration, with the help of the Fermi neutrino theory, of the possibility of diffusion of light by neutrons suggests a mechanism by which energy exchanges between an external field and the neutron can take place, and that when the external field is due to electromagnetic radiation diffusion exists. A preliminary examination of probability considerations is outlined. N. M. B.

175. Scattering of Light by Light According to the Born-Infeld Theory. C. D. Thomas. *Phys. Rev.*, 50. *pp.* 1046–1049, *Dec.* 1, 1936. The nonlinearity of the unquantised Born-Infeld field equations leads to the prediction that light should scatter light. The result follows also from the Dirac electrodynamics ; however, the natures of the effects are essentially different. Whereas in the quantum electrodynamics a photon interpretation proves tenable, in the Born theory such is not the case. Here the scattering occurs only if the proper relationship exists between the frequencies and directions of the incident beams, and the scattering takes place only into certain frequencies and directions characteristic of the initial radiation. It is found that the two theories are comparable as to order of magnitude and dependence on the frequency. AUTHOR.

***176. Echelon Compensation for the Jamin Interference Refractometer Illuminated with White Light. H. Billing.** *Zeits. f. Physik*, 103. 1–2. *pp.* 57–60, 1936.—A compensator is described consisting of an echelon of glass or mica with a step thickness of 10 μ which is introduced into one of the interfering beams. With the aid of this device the displacement of the monochromatic dark fringe can be read off directly on the scale in the telescope eye-piece over an extended range of refractive-index variation without rotation of a compensator drum. W. S. S.

See also Abstracts 304, 305, 402.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

177. Formation of Phosgene from Chloroform, Chlorine and Oxygen, Sensitised by Irradiated Chlorine. H. J. Schumacher and D. Sundhoff. *Zeits. f. phys. Chem.* 34. *Abt.B.* 3–4. *pp.* 300–308, 1936.—EtOH, MeOH and NH_3 almost completely stop the formation of $COCl_2$ in light from Cl_2, $CHCl_3$ and O_2. This suppression is due to the removal of the Cl atoms by these substances which either become chlorinated or give decomposition products. The completely chlorinated substances do not suppress $COCl_2$ formation. [See Abstract 4158 (1934).] J. K.

178. Photochemical Reactions of Liquid and Dissolved Ketones. E. J. Bowen and A. T. Horton. *Chem. Soc., J. pp.* 1685–1688, *Nov.*, 1936.—It is confirmed that the products of the photochemical decomposition of acetone dissolved in *n*-hexane or in cyclohexane are an alcohol together with a substance which is capable of absorbing Br_2 rapidly from a moist solution in CCl_4. The solvent takes part in the reaction. C. B. A.

179. Photochemical Reactions in the Fluorite Region. Part I. Photochemical Decomposition of Ethylene. R. D. McDonald and R. G. W. Norrish. *Roy. Soc., Proc.* 157*A*. *pp.* 480–489, *Dec.* 2, 1936.—Light from a hydrogen lamp is passed directly through a fluorite window into C_2H_4 at pressures most below 1 mm. The total pressure never varies by more than a few per cent., although a polymer is deposited on the window, and H_2 as well as a condensable gas is formed. The latter can be separated into two fractions, one of which evaporates at $-170°$ to $-160°$, the other at $-140°$ to $-130°$ at the low pressures involved. The variation of the rate of H_2 formation with the C_2H_4 pressure is such as to indicate that the light is not completely absorbed at the lowest pressures used. Possible mechanisms for the reaction are discussed. AUTHORS.

180. Quantum Yield of the Photosensitised Decomposition of Water and of Ammonia. H. W. Melville. *Roy. Soc., Proc.* 157*A*. *pp.* 621–624, *Dec.* 2, 1936.—With the object of finding the maximum rate of exchanges due to the possible dissociation of hydrides and reaction of the resultant gases with Hg, measurements are made and experimental and calculated results are tabulated and discussed of the quantum yields of the decomposition of H_2O, D_2O, and NH_3 at various temperatures in presence of Hg vapour. [See Abstract 4970 (1935).] N. M. B.

181. Theory of Photographic Developability. J. E. de Langhe. *Zeits. f. wiss. Phot.* 35. *pp.* 201–210, *Sept.–Oct.*, 1936.—The author shows it to be possible to reconcile the older silver-speck theory with Schwarz's "surface-discharge" theory of developability. Light action (on AgBr) produces simultaneously an Ag atom and a gap in the protective Br^- layer, at which AgBr may more readily pass into solution; here it is reduced by the developer, the Ag atom or atoms acting as a nucleus for Ag deposition. The surface-discharge theory provides explanations of (i) developability induced by shear, (ii) general fogging caused by such positive reducing agents as Sn^{++} and (iii) ready developability of flocculated negative AgBr sols. Extended treatment of (iii) leads to the conclusion that an AgBr grain is developable if the potential at its surface, dependent on the character and thickness of the surface layer, falls below a threshold level and if, also, the Ag atoms produced at the instant development commences aggregate to form a nucleus of sufficient size. L. V. C.

182. Photometric Constant. J. Eggert and A. Küster. *Zeits. f. wiss. Phot.* 35. *pp.* 233–234, *Sept.–Oct.*, 1936.—The photometric constant P, so termed by Hurter and Driffield, is actually not a constant, but is dependent solely on the average grain size *d*, this grain size in microns being given by $6{\cdot}8 \log Q$, where Q is the Callier quotient. From the determination of P and *d* for different blackenings, emulsions, developers and development times a single straight-line graph is obtained, thus illustrating the relationship between P and *d*. This, however, does not hold for dyed layers, for developers which produce coloured silver, or for bad under-development. Further, the simple linear relationship gives an easy means of determining the mass of silver per 100 cm^2. of layer surface. R. C. F.

183. Weber's Desensitisation Theory. M. Blau and H. Wambacher. *Zeits. f. wiss. Phot.* 35. *pp.* 211–215, *Sept.–Oct.*, 1936.—Deals with the desensitisation theory recently suggested by Weber [see Abstract 2691 (1936)], considering previously published and new results, all of which tend to disprove the main arguments of this new theory. R. C. F.

184. Capri Blue Effect and Ripening Process. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 35. *pp.* 216–228, *Sept.–Oct.*, 1936.—Gives the results of further experiments which show pronounced increase of sensitivity of large-grained AgBr emulsions produced by capri blue. These results, when considered with previously published results of the present and other authors, show that the capri blue effect is only obtainable with very dilute solutions and with AgBr grains covered with a thin highly-dispersed AgI layer. Further, it is not a true sensitising action but rather is the effect due to the removal of the slightly sensitive outside layer which obstructs the photochemical decomposition [see Abstract 1604 (1932)]. R. C. F.

185. Digestion of Peptonised Silver Bromide. A. Randolph. *Zeits. f. Physik*, 103. 5–6. *pp.* 414–420, 1936.—By successive additions of

AgBr to gelatin solution, under simultaneous action of peptonising means and maturing substances, peptonised emulsions of various grain size are produced. Such emulsions are more sensitive than those of the same grain size produced by common methods. The sensitivity depends on the physico-chemical state of the AgBr grains as well as on the size of crystal. J. E. K.

186. Present State of the Theory of the Latent Image. J. Eggert. *Zeits. f. wiss. Phot.* 35. *pp.* 230–233, *Sept.–Oct.*, 1936.—Deals with the present state of knowledge regarding the latent image, considering its formation by three different means—by light, by X-rays, and by corpuscular radiations rich in energy. R. C. F.

187. Effect of Pre-Exposure in Spectrum Photography. D. Norman. *J.O.S.A.* 26. *pp.* 407–408, *Nov.*, 1936.—The effect of pre-exposure on Eastman 40, 50, 1-G, I-F, and Cramer Hi-Speed plates is investigated and found to be similar on all five. The optimum pre-exposure density in every case, as was to be expected, is equal to the density at the beginning of the straight line portion of the D-log I curve. The eliminate the Herschel effect, it is found necessary to pre-expose with a light source having an effective wave-length longer than the wave-length of any portion of the spectrum which is to be used for density measurements. A definite fading of the latent image amounting to a density decrease of 0·07 at a density level of 0·8 is observed in plates which are developed 12 hr. after exposure. This fading ceases, in the cases studied, after about 20 hr. AUTHOR.

188. Spark Photography and Kinematography in the Study of Ballistic and Aerodynamic Phenomena. I. Libessart. *Soc. Franç. Phot. et Ciné, Bull.* 23. *pp.* 192–204, *Sept.*, 1936.—Deals briefly with ultra-rapid spark photographic and kinematographic methods for the examination of ballistic and aerodynamic phenomena. The sections considered are ordinary instantaneous photography, continuous recording, technique of photography by electric discharge, gaseous vapour discharge, point spark and indication of the compression or dilatation conditions of the air, stereoscopy of gaseous jets, and normal, rapid and ultra-rapid kinematography. Finally, stereoscopic kinematography, which is being developed in order to study various mechanical and ballistic phenomena, is briefly mentioned. R. C. F.

189. Photochemical Foundations of New Colour-Film Processes. *Phot. Indust.* 34. *pp.* 1221–1223, *Nov.* 11 *and pp.* 1250–1254, *Nov.* 18, 1936.—The processes surveyed are subtractive processes in which dyes already present are bleached (*e.g.* Gaspar process) or dyes are formed from their components, wherever a silver image is developed. The second group is more extensively considered ; in these processes the oxidation-product of the developer forms a dyestuff with a second component (the " colour former ") added either to the developer or to the sensitive emulsion. Three-colour subtractive processes require the use of three emulsion layers ; three dyes of appropriate colour may be produced in these either by successive depth-controlled processing as in Mannes and Godowsky's process, or simultaneously (as in a new Agfa process) if three appropriate colour-formers are present in the respective emulsion layers. The principal reactions are summarised. L. V. C.

190. Colour Photogravure. H. M. Cartwright, Q. Mansfield and E. L. Turner. *Phot. J.* 76. *pp.* 558–569 ; *Disc.*, 569–572, *Nov.*, 1936. —Establishes a systematic basis for colour photogravure and suggests

exact methods for the routine production of satisfactory commercial work by craftsmen skilled in monochrome gravure but not otherwise specially trained. The technique at present in use gives uncertain results owing to lack of satisfactory control. Photographing on the straight line part of the plate curve gives satisfactory gradation, constant results being obtained by photographing a scale of tones included with the original. The character of the negative should not be altered for different types of originals, and the full range of the negative should be recorded on the straight line of the positive plate. In order to secure uniform and reasonably constant results in the carbon printing technique a controlled system of etching is used to compensate for all normal variations, the total etching time being determined by preliminary trials with the printing inks. These printing inks should be balanced to give a neutral grey when printed in superposition from an etched scale, and should conform as closely as possible to the accepted standard for three-colour printing. Using this system it is possible to give a quantitative method of colour correction and a technique has been developed for making and using colour-charts. R. C. F.

***191. Distance Meter in Photography. N. Günther and J. Rzymkowski.** *Zeits. f. wiss. Phot.* 35. *pp.* 229–230, *Sept.–Oct.*, 1936.—Deals briefly with the general error formula containing the conditions for the choice of the elements of construction of the distance meter, indicating the modifications introduced in the expression by various forms of meters. R. C. F.

192. Separation of Approaching Lines. G. Nidetzky. *Phot. Indust.* 34. *pp.* 1310–1317, *Dec.* 2, 1936.—Parallel lines after photographing appear as non-parallel lines on the negative if a fixed objective lens of medium angle is used, this condition being capable of correction if an enlarged print is made. The present author examines geometrically the conditions for complete elimination of the errors, and illustrates methods of obtaining these results during enlargement of the negative. R. C. F.

See also Abstracts 23, 101, 368.

PHOTOMETRY.

193. Photometric Measurement of Line Sources. D. Vermeulen and J. G. Hagedoorn. *K. Akad. Amsterdam, Proc.* 39. 9. *pp.* 1089–1092, 1936.—Describes a new method of measuring the brightness of a narrow (line) field. It is particularly useful when the brightness is small, as in spectrophotometry or spectral pyrometry near the ends of the spectrum. Images of the field to be measured and of a standard source are presented alternately to the eye at a speed of about one complete cycle per seond. The method, which is found to be quite sensitive, can also be applied to the spectrophotometry of the ultra-violet, using fluorescent screens. J. W. T. W.

***194. Simple Apparatus for Measuring Microphotometer Curves. H. Oehler.** *Zeits. f. Instrumentenk.* 56. *pp.* 464–466, *Nov.*, 1936.—A device is described for obtaining quickly and accurately the rectangular coordinates of any point on a microphotometer curve. The apparatus consists essentially of a pair of rotatable cross-wires which can be moved across the curve along a graduated scale, which itself moves, at right angles to the former motion, along a second scale. Both scales are read by verniers to 0·1 mm. The device compromises between the slow operation

of the more complicated Toepfer-type apparatus and the inaccuracy of simple methods using set-squares. It is claimed that systematic errors are excluded and that those which remain are less than the intrinsic errors involved in methods of photographic photometry. A. Hu.

See also Abstract 187.

POLARISATION.

195. Polarisation of Hard X-Rays. E. Rodgers. *Phys. Rev.* 50. *pp.* 875–878, *Nov.* 15, 1936.—A study has been made of the polarisation of X-rays scattered at 90° from the primary beam for various voltages ranging from 80 to 800 kV. The scattered rays were again scattered at 90° and a Geiger-Müller counter was used to determine the relative intensities of the tertiary rays in directions parallel and perpendicular to the primary rays. At 80 kV the polarisation was found to be practically complete, but it was found to decrease to 69·6 % as the X-ray tube voltage was raised to 800 kV. Within the limits of experimental error, the results agree with Nishina's theory which predicts an unpolarised component in the secondary X-rays increasing in relative magnitude as the frequency of the primary rays becomes greater. AUTHOR.

196. Circular Dichroism of Solutions of Camphor in Organic Solvents. G. Bruhat and P. Guénard. *Comptes Rendus*, 203. *pp.* 784–786, *Oct.* 26, 1936.—Dilute solutions of camphor in CCl_4, C_6H_{14}, C_6H_{12} and C_6H_6 give identical curves of circular dichroism inside the ketonic absorption band at about 3000 Å. In alcohol the curve is displaced but is otherwise unchanged. The contribution of this band to the rotatory power is therefore independent of solvent, and the observed solvent effect must be a variation of the laevo-rotation contributed by bands of shorter wave-length. It cannot be attributed to modification of the proportions of two forms of molecule in equilibrium. C. B. A.

197. Circular Dichroism of Solutions of Camphor in Water and in Acids. G. Bruhat and P. Guénard. *Comptes Rendus*, 203. *pp.* 862–864, *Nov.* 3, 1936.—The circular dichroism of an aqueous solution of camphor has about the same values as for solutions in organic solvents, but the maximum is displaced slightly towards shorter wave-lengths, whilst the half-width is also diminished. The dextropartial rotation due to the ketonic band is therefore slightly diminished. Addition of mineral acids causes only a further small displacement of the maximum. The very marked effect of H_2SO_4 on the rotatory power must therefore be due to a change in the laevopartial rotation due to absorption at shorter wave-lengths. There is no evidence for a variation of the number of dextro-rotatory centres present. C. B. A.

***198. Dichroitic Crystals and Their Use as Polarisation Filters. M. Haase.** *Zeits. f. wiss. Phot.* 35. *pp.* 236–237, *Sept.–Oct.*, 1936.—A brief note dealing with the new methods of producing polarisation filters, comparing the Zeiss-Herotare filter with the Polaroid filter from the U.S.A., the possible uses of the filters being considered. R. C. F.

***199. Polarisation Prism. W. A. Osipov-King.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 2. *pp.* 53–56, 1936. *In German.*—A polarising calcite prism for use in the ultra-violet is described in which the air film is replaced by a thin plate of fused silica. C. B. A.

***200. Polaroid Half-Shade Analyser. A. H. Pfund.** *J.O.S.A.* 26. *p.* 453, *Dec.*, 1936.—By cementing a half-wave plate of cellophane over a

portion of a sheet of Polaroid, two fields, separated by a photometric line of demarcation are produced. Since the directions of vibration of the polarised light in the two fields are mutually perpendicular, a sensitive device for the detection of polarised light is realised. AUTHOR.

See also Abstracts 42, 170, 210, 211 254,

RADIATION, EMISSION.

201. Ultra-Violet Radiation in the Reboul Effect. O. Viktorin. *J. de Physique et le Radium*, 7. *pp.* 461–465, *Nov.*, 1936.—An investigation, by means of photoelectric counters, of the action of an electric field on the semiconductors, black paper, NaCl, HgCl, NaF, PbI_2, KNO_3, and $K_2C_2O_4$, showed the emission of u.v. radiation. Full data are tabulated for counters of different spectral sensitivity (CuI and Al), and show that the radiation lies within the range 2600–2000 Å. N. M. B.

202. Hard Secondary Cosmic Radiation. H. Maass. *Ann. d. Physik*, 27. 6. *pp.* 507–531, *Nov.*, 1936.—With a vertical coincidence counting arrangement comparisons were made of the counting rate with an absorber between the counters and above the counters. The difference between these rates for the same thickness represents a secondary radiation originating in the absorber. The curve showing this difference against thickness for Fe shows a maximum at 2 cm. and another at 30 cm., which corresponds to a penetrating secondary radiation with a maximum range of 35 cm. of Fe. This radiation has an absorption coefficient of $0{\cdot}08$ cm.$^{-1}$ Fe and is believed to be produced by photons with an absorption coefficient of $(9 \pm 4) \times 10^{-3}$ cm.$^{-1}$ Fe. D. H. F.

203. Cosmic-Ray Showers. N. Ivanova. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 2. *pp.* 49–52, 1936.—A sheet of Pb, 16 mm. thick, was placed over a set of three counters disposed for counting showers, and observations made of the variation of the triple coincidence rate with the thickness of an Al screen placed between the Pb and the counters. A discontinuity appears at 35 mm. An absorption coefficient for the shower particles is deduced, but it does not agree with that advocated by Geiger and Funfer [see Abstract 1599 (1935).] Observations on the shower-rate with 16 mm. of Pb under a filter 16 mm. thick placed some distance above disagree also with the same authors' absorption coefficient for the shower-producing radiation. D. H. F.

204. Cosmic-Ray Showers. P. Auger and P. Ehrenfest. *J. de Physique et le Radium*, 7. *pp.* 473–475, *Nov.*, 1936.—A statistical study is made of the angular distribution of the rays forming showers, from photographs obtained with a counter-controlled Wilson chamber at an altitude of 3500 m. It is found that the most probable value of the semi-divergence of the rays of a shower (semi-divergence is defined as the mean of the absolute angles made by the individual rays with the axis of the shower) is about 18°. The measurements were made on one plate only of each stereoscopic pair, and thus represent a projection of the true angles made by the rays with the vertical. D. H. F.

205. Cosmic-Ray Showers at High Altitudes. P. Auger, P. Ehrenfest, Jr., and A. Fréon. *Comptes Rendus*, 203. *pp.* 1082–1084, *Nov.* 23, 1936.—Shower measurements were made with counters under two semi-cylindrical Pb screens, one of radius 6 cm. and the other of radius 45 cm., about the counters as axis. Series of curves were obtained for different thicknesses of each screen. The showers due to the 45 cm.

screen by itself were few, but in conjunction with small thicknesses of the 6 cm. screen (up to 10 mm.) the 45 cm. screen produced a rapid increase in shower rate as its thickness increased. In all cases the maximum rate was produced when the total Pb thickness was between 20 and 25 mm. It is concluded that the shower particles, and the photons accompanying them, are capable of producing fresh showers in the Pb traversed after their formation. D. H. F.

206. Cosmic-Ray Shower Production and Absorption in Various Materials. J. E. Morgan and W. M. Nielsen. *Phys. Rev.* 50. *pp.* 882–889, *Nov.* 15, 1936.—Measurements have been made of shower production in thin pieces of C, Al, Cu, Sn and Pb. The results as shown by a study of three and twofold showers for thicknesses of 0·58 and 0·29 cm. Pb mass equivalent thickness and for several different experimental arrangements, indicate that the increase in counting rate associated with each atom in the producing material varies as the $2{\cdot}0 \pm 0{\cdot}2$ power of the atomic number of the element concerned. Our measurements indicate that the increase in counting rate for heavy elements such as Pb increases faster that the first power of the thickness of producing material. The departure from linearity seems to be a function of atomic number, being greater for elements of large Z. Absorption measurements of showers from Pb, in Pb, Sn, Cu, Al and C show that the absorption per atom varies between the first and second powers of the atomic number. Rossi transition curves for Pb, Fe and Al are presented. In the case of Fe and Al these measurements are extended to larger thicknesses than in previous investigations. AUTHORS.

207. Precision Cosmic-Ray Measurements near the Top of the Atmosphere. R. A. Millikan, H. V. Neher and S. K. Haynes. *Phys. Rev.* 50. *pp.* 992–998, *Dec.* 1, 1936.—Self-recording, constant pressure A-filled electroscopes sent into the stratosphere by sounding balloons at San Antonio, Texas, mag. lat. 39° N, yielded accurate readings of cosmic-ray intensities up to an altitude 98·3 % of the way to the top of the atmosphere, where the pressure is but 12·9 mm. of Hg. The ionisation within these electroscopes passes through a definite maximum at 47·6 mm. of Hg and falls 22 % in rising to where the pressure is 12·9 mm. of Hg. These results, combined with similar accurate measurements on the variation of cosmic-ray intensities as a function of latitude, both at sea level and at altitudes of 22,000 ft., indicate (1) that atmospheric cosmic-ray ionisation is not produced in appreciable amount by incoming protons, and (2) that the Oppenheimer-Bethe-Heitler law of nuclear absorption is not valid for incoming electrons of a few billion eV of energy. AUTHORS.

***208. Electric Welsbach Lamp. A. H. Pfund.** *J.O.S.A.* 26. *pp.* 439–442, *Dec.*, 1936.—This lamp is to serve as a source of radiation from the visible into the far infra-red. The heating unit consists of sheets of ashed Welsbach mantle heated by the glow or arc discharge formed between terminals connected to the secondary of a h.v. transformer. When operated in air, a small, pointed gas flame is allowed to play on the mantle, thus steadying the electrical discharge and increasing the temperature. From 0·7 to 15μ, gas plus electricity are used, whereas, from 15μ to 150μ, gas alone is employed. When the lamp is operated in a partial vacuum, variations in spectral distribution are effected largely by working at different pressures. At pressures around 10 cm. the emission is similar to that of the gas Welsbach in the region of longer wave-lengths, while at

pressures near 30 cm. the emission rivals that of a Nernst lamp in the near infra-red (0·7 to 15μ). AUTHOR.

RADIATION, GENERAL THEORY.

209. Relativistically Invariant Formulation of the Neutrino Theory of Light. R. de L. Kronig. *Physica*, 3. *pp.* 1120–1132, *Dec.*, 1936. *In English.*—The neutrino theory of light, as developed by Jordan and Kronig, is given a relativistically invariant formulation by describing the neutrino field in terms of wave functions obeying Dirac's equation, the electromagnetic field on the other hand in terms of the six-vector E, H, and by expressing the Fourier coefficients of E and H as functions of the amplitudes of the neutrino field. Upon subjecting the latter to the commutation relations characteristic of particles satisfying Pauli's exclusion principle, there result for E and H the well-known commutation relations of the electromagnetic field vectors. The new view-point has as a consequence that in the formalism, previously developed by Jordan and Kronig, the two components of the wave function associated with the neutrinos must be considered as referring to states with positive and negative energy rather than to states differing by the orientation of the neutrino spin, a conclusion also arrived at recently by Born and Nagendra Nath. AUTHOR.

See also Abstract 162.

REFLECTION, REFRACTION AND DISPERSION.

210. Selective Reflection of Silver and Zinc in Polarised Light and the Selective Photoelectric Effect. F. Hlučka. *Zeits. f. Physik*, 103. 3–4. *pp.* 237–245, 1936.—The reflection curves for polarised light in Ag and Zn in the spectral region 3660 to 2380 Å have been obtained. Two characteristic frequencies are found, one giving a double maximum and the other a single one. The results of earlier investigations with the same specimens are compared with the curves obtained here and the maxima in the photoelectric spectral distribution curves compared with those in the reflection curves. It is shown that one characteristic frequency corresponds to the photoelectric maximum for light polarised in the plane of incidence, the other to that polarised in the perpendicular plane. Further the two maxima in the reflection curve corresponding to a single frequency are related to the photoelectric emission in the opposite sense, the shorter waves corresponding to light polarised in the plane of incidence. J. E.

211. Polarimetric Determination of Optical Properties. R. M. Emberson. *J.O.S.A.* 26. *pp.* 443–449, *Dec.*, 1936.—An attempt to determine the thicknesses of thin films by the polarimetric method evolved into a study of the method itself. This paper contains a summary of the equations and a description of the experimental technique used in the study, as well as experimental results. It has been found that the optical constants of metals are practically independent of the angle of incidence. Film thicknesses, calculated from polarimetric data, were found to be of the correct order of magnitude but not to be independent of the angle of incidence. Also, the computed thicknesses were always complex. AUTHOR.

212. Optical Constants of Fluorite in the Extreme Ultra-Violet. R. Tousey. *Phys. Rev.* 50. *pp.* 1057–1066, *Dec.* 1, 1936.—The reflecting power of a polished fluorite surface has been measured at 19 wave-lengths from 1605 to 927Å for 45°, 60°, 75° and 85° incidence, by means of a

vacuum spectrograph. The method of photographic photometry followed is discussed in detail. The reciprocity law was employed and correction made for its failure in accordance with the work of Harrison and Leighton on oiled photographic films. Correction exposures were made with an inverse square law sensitometer. A vacuum chamber was arranged for this sensitometer since it was found that the reciprocity characteristics of the film were changed when it was placed in a vacuum. The reflecting power data above 1230Å shows that the light dispersed by the grating was very nearly unpolarised. The curves for index of refraction and extinction coefficient have been computed from the reflecting power data for fluorite. The extinction curve shows an absorption band of roughly 100Å half-width, with maximum near 1115Å. The dispersion is anomalous in this region. The absorption increases again below 1060Å. The condition of the fluorite surface is discussed. Evidence is given indicating the presence of a surface layer having a higher absorption coefficient and reflecting power than fluorite itself. AUTHOR.

213. First-Order Laws in Asymmetrical Optical Systems. Part II. M. Herzberger. *Kodak Research Lab., Comm. No.* 593. *J.O.S.A.* 26. *pp.* 389–406, *Nov.*, 1936.—An entirely mathematical discussion of the problems of optical image formation and especially of image errors. [For Part I see Abstract 4689 (1936).] A. H.

214. Change in the Intensity of a Ray on Refraction. M. M. Gurevič. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 2. *pp.* 47–48, 1936.—The intensity of a light ray in passing from air to glass at normal incidence is by theory multiplied 2·3 times. This cannot be observed because of the second refraction the ray must undergo, but the result is verified by observing the flux of diffuse light. The light from a whitened sphere 40 cm. dia. passes through an aperture in a metal screen placed against a hole in its wall into a second whitened sphere against a hole in which a photometer is directed. Two glass hemispheres diameter 4 cm. are then placed on each side of the screen, the space filled with a liquid of the same refractive index as the glass, and a second measurement taken. The ratio of the fluxes is 2. Reflection and absorption reduce the theoretical value 2·3 to 2·03. H. G. C.

215. Refraction of Iodine Vapour and Atomic Iodine. A. Braun and P. Hölemann. *Zeits. f. phys. Chem.* 34. *Abt.B.* 5. *pp.* 357–380, 1936.—The refraction of I_2 vapour is determined by an interferometric method for a wave-length of 656·3 mμ, the measurements being made at temperatures between 150° C. and 1030° C. and at concentrations between 1×10^{-5} and 4×10^{-5} gm./cc. The concentrations of I_2 are determined by electrometric titration after washing out with KI solution. The observed decrease of refraction above about 600° C. is interpreted as due to dissociation into atoms and from the results at the higher temperatures the value $13 \cdot 4 \pm 0 \cdot 2$ cm^3. is deduced for the refraction of atomic I. The refraction of atomic I for infinitely long waves is calculated to be $12 \cdot 5 \pm 0 \cdot 2$ cm^3. The principle of additivity is tested by comparing the experimental data for the refraction of solid KI and vaporous HgI_2 and HI with values computed by adding the respective atomic or ionic refractions. L. A. W.

216. Mechanical Double Refraction of Oils in Relation to Molecular Structure and Association. D. Vorländer and P. Specht. *Zeits. f. phys. Chem.* 178, *Abt.A.* 2. *pp.* 93–112, 1936.—This paper records

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new measurements with experimental details and data on the mechanical anisotropy of oils, which furnish an insight into the structure of liquids. H. H. Ho.

***217. Microscopy with Fluorescent Light. C. J. Frosch and E. A. Hauser.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 423–426, *Nov.* 15, 1936.—By use of a metallurgical type of illuminator using reflected light, opaque subjects may be investigated as well as microtome sections. An arc between cored iron electrodes gives a steady source of light rich in u.v. radiation. Depth of penetration of colourless fluorescent liquids into coloured porous solids, *e.g.*, in tanning of leather, may be determined, and the same method may be applied to non-fluorescent liquids by addition of small quantities of fluorochromes. Certain dyes, *e.g.*, primulin, are preferentially absorbed between different components in wood fibre, giving pink, blue and green fluorescence, in contrast to the uniform natural blue fluorescence of the wood. Possible applications in the study of emulsification, ore flotation, wood preservation and detection of moulds are discussed, with useful practical hints. D. R. H.

See also Abstracts 41, 90, 114, 176, 199, 275, 338.

SPECTROSCOPY.

218. Extreme Ultra-Violet Wave-Length Standards. K. R. More and C. A. Rieke. *Phys. Rev.* 50. *pp.* 1054–1056, *Dec.* 1, 1936.—In order to be certain that the extreme u.v. wave-length standards are not subject to the small errors inherent in the method of overlapping orders the wave-lengths of several lines of C, N and O have been determined by a method which is free of that objection. This has been accomplished by the comparison, using a 2 m. normal incidence vacuum spectrograph, of the first order of the lines in question with the first order of certain lines of the Cu II spectrum. The wave-lengths of these Cu II lines have been computed with considerable accuracy by Shenstone by the use of the combination principle. The values obtained in the present investigation are in good agreement with those of Boyce and Rieke, and of Weber and Watson, which were obtained by the method of overlapping orders. Since the results of three investigations are now in satisfactory agreement, mean values, suitably weighted, are suggested for use as extreme u.v. wave-length standards. Authors.

219. Wave-Lengths in H_2 Spectrum From λ3612 to λ4224. N. A. Kent. *Astrophys. J.* 84. *pp.* 585–599, *Dec.*, 1936.—The wave-lengths of 513 lines of H_2 are measured on plates taken with a 21-foot concave grating at the California Institute of Technology. The results are compared with the measurements by Gale, Monk, and Lee, and by Finkelnburg. Author.

220. Pressure Effects on Spectral Lines. H. Margenau and W. W. Watson. *Rev. Modern Physics*, 8. *p.* 398, *Oct.*, 1936.—A correction. [See Abstract 680 (1936).]

221. Absorption and Emission Spectra of Rare Earth Ions. H. Gobrecht. *Zeits. f. techn. Physik*, 17. 11. *pp.* 425–426, 1936. *Phys. Zeits.* 37. *pp.* 851–852, *Dec.* 1, 1936.—Trebly-ionised rare earths give very sharp spectra which permit accurate investigation of the internal fields from observation of the Stark effect splitting. Measurements in the infra-red on Sm^{+++} and Pr^{+++} have established certain transitions from which

selection rules are deduced, while Stark effect observations on Eu show that Eu^{+++} in $Eu_2(SO_4)_3 \cdot 8H_2O$ is in a crystal field of hexagonal symmetry. F. S.

222. Extreme Ultra-Violet Spectrum of Mercury. L. Bloch and E. Bloch. *Ann. de Physique*, 6. *pp.* 561–574, *Nov.*, 1936.—Carroll [see Abstract 1354 (1926)] has measured the Hg spectrum to 740Å. Using a tangential grating, this has now been extended to 220Å. Carroll's measurements have been repeated using a grating at normal incidence, and separation of the lines according to various degrees of ionisation attempted. Wave-lengths from 1727 to 222Å are tabulated. F. S.

223. Infra-Red Spectroscopy in Rubber Chemistry. D. Williams. *Physics*, 7. *pp.* 399–402, *Nov.*, 1936.—The applicability of infra-red methods to some problems arising in the chemistry of rubber is demonstrated. The spectra of isoprene, styrene, polymerised butadiene, and several types of rubber are studied and certain variations in the $5 \cdot 5\ \mu$–$6 \cdot 5\ \mu$ regions are attributed to changes occurring during the processes of polymerisation. The effects of vulcanisation also appear in the spectra of the rubber samples. The methods of infra-red analysis do not necessitate the use of solutions of rubber compounds in CCl_4 or CS_2 as in the case of previous Raman work. AUTHOR.

224. Transition-Probability in the Copper Spectrum. D. van Lingen. *Physica*, 3. *pp.* 977–994, *Nov.*, 1936. *In German.*—An expression for the ratio of intensity of two lines is obtained and used in an investigation of the arc between Ag electrodes in air and in N_2 at atmospheric pressure. A thermal type of arc is found and used to determine the transition-probability in the Cu arc. F. S.

225. Line Intensity Variations in the Hydrogen H.F. Glow Discharge. G. W. Fox and C. H. Bachman. *Phys. Rev.* 50. *pp.* 939–942, *Nov.* 15, 1936.—Intensity variations in the lines of the Balmer series as excited in a h.f. "glow" discharge in H_2 for a wave-length range of $5 \cdot 1$ to $32 \cdot 5$ m. and pressure range of 5 to 300 microns are studied spectroscopically in conjunction with a logarithmic sector disc. The results of the investigation indicate that a distinct variation in intensity ratios with excitation frequency exists. A region of excitation frequencies is found which produces minimum excitation of each term with respect to H_α and further, this region depends on the pressure and the term under consideration. Ionisation efficiency and intensities of the higher series terms vary more or less directly with each other if cumulative ionisation is negligible. The intensities of the higher terms increase with decreasing pressure down to about 10 microns below which H_β and H_γ continue to increase in intensity while the higher terms decrease. If a value $e^{-0.1(f/10^7)^2}$ be chosen for $\phi(f)$ in J. Thomson's equation for the striking voltage for this type of discharge, curves can be calculated in good general agreement with the experimental results. AUTHORS.

226. Nuclear Magnetic Spins. C. J. Gorter. *K. Onnes Lab. Leiden, Comm. No.* 247*a*. *Physica*, 3. *pp.* 995–998, *Nov.*, 1936. *In English.*—Nuclear spins subjected to a strong magnetic field may occupy different orientations which have different energy levels. An attempt to detect transitions between these levels has a negative result, which indicates that the interaction between the nuclear spins and the vibrations of the crystalline lattice is very small. G. E. A.

227. Ground State of the Hydrogen Molecule. T. Nagamiya. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 497–506, *Oct.*, 1936. *In English.*—The dissociation energy and the wave function at the equilibrium distance

of the nuclei are obtained by the method of molecular orbitals. A modification of the treatment of James and Coolidge is employed [see Abstract 198 (1934)] and some of its disadvantages removed, but the result for the dissociation energy is poorer. H. G. C.

228. Radiation Damping and Fine Structure of the Balmer Lines of Hydrogen. J. Meixner. *Ann. d. Physik*, 27. 5. *pp.* 389–404, *Nov.* 1936.—Various investigators have recently found that the distance of the centre of gravity of the doublet components of the Balmer lines is 0·010 cm.$^{-1}$ less than the theoretical value deduced from Sommerfeld's fine structure formula and that the distance between the most intense and the shortest wave-length components of the H_α line of deuterium D_α is 0·134 cm.$^{-1}$ compared with the theoretical value of 0·108 cm^{-1}. The factors which might theoretically cause deviation from the Sommerfeld formula are critically examined and most of them are readily shown to give deviations of the wrong kind or order from those observed. Two of the factors are only eliminated as possible means of explanation after detailed calculation of their effects; these are the interaction of a radiating atom with the radiation field and the mutual interaction of two neighbouring atoms which simultaneously emit approximately the same frequency. The only assumption on which the deviations might be explained is that of Born and Schrödinger that the electron radius is essentially determined by the magnetic energy instead of by the electrostatic energy of the spin electron. Since, however, there are some rather serious objections to this explanation it is concluded that it is most probable that the observed effects are not real, but result from over-estimation of the accuracy of the measurements. J. E. K.

229. Fock Equations for Complex Configurations. G. H. Shortley. *Phys. Rev.* 50. *pp.* 1072–1075, *Dec.* 1, 1936.—Fock's equations for a general atomic state are written in terms of the coefficients of Slater's F's and G's in the energy of that state. With the special formulae which are given to take care of the closed shells, this enables the Fock equations to be written down immediately for any desired state. For a complex configuration, in order to obtain *one* particular set of radial factors to use as a basis for a first-order perturbation calculation, a process is given for obtaining that set of radial factors for which the centre of gravity of the configuration is a minimum, for any coupling. Finally, it is shown how equations may be obtained for finding the best radial factors with which to form the eigenfunctions of a *given term* of a configuration in LS coupling, and suggested that this may be made the basis of a perturbation theory in which the different types of terms are considered independently. AUTHOR.

230. Near Infra-Red Absorption and Raman Spectra of Nitrogen Derivatives. Part II. Amines. (Mme.) M. Freymann and R. Freymann. *J. de Physique et le Radium*, 7. *pp.* 476–480, *Nov.*, 1936.—A systematic study has been made of the absorption spectra, from 0·8 to 1·2 μ, of primary and secondary, aliphatic, aromatic and heterocyclic amines; the results are compared with those deduced from Raman spectra and from the first infra-red harmonic. The aromatic, primary and secondary amines show, in comparison with the aliphatic, a displacement of the NH band towards higher frequencies. The substitution of CH_3, I, Br or Cl in aniline results in small displacements of the NH bands, the displacements being related to the electric moments of the substituted groups. Examinations of pyrrol and piperidene suggest the existence of several molecular forms in equilibrium. [See Abstract 1206 (1936).] D. H. F.

231. Absorption Spectrum of Benzene and its Derivatives (6000–9500 Å). P. Barchewitz. *Comptes Rendus*, 203. *pp.* 930–933, *Nov.* 9, 1936.—Absorption cells 30 and 100 cm. long are employed and the spectra obtained with a self-recording spectroscope. All the compounds show the harmonics of the C_6H_6 fundamental (3·27 μ) at about 0·87, 0·71, and 0·61 μ and the band at 0·804 μ. In $C_6H_5NO_2$ the 0·87 and 0·71 bands are double. Compounds containing (CH –) also show bands at 0·745 and 0·91 μ which in $C_6H_5CH_3$, $C_6H_4(CH_3)_2$ (1,3) and $C_6H_4.CH_3.OH$ (1, 2) are double. Substitution of an electronegative group produces a displacement of the (CH =) bands to shorter wave-lengths, of an electropositive group to longer [see Abstract 5332 (1933)]. The displacements are additive. H. G. C.

232. Diffuse Band System of the $SeCl_2$ Molecule. M. Wehrli. *Helv. Phys. Acta*, 9. 8. *pp.* 637–639, 1936. *In German.*—The vapour of Se_2Cl_2 is shown to contain $SeCl_2$. Above 240° C. the absorption spectrum becomes very similar to that observed for $SeBr_2$, and the characteristics of the bands, which are attributed to $SeCl_2$, indicate that it is a fluctuation spectrum. The valence vibrations in the ground state have a frequency about 300 cm^{-1}. C. B. A.

233. Absorption Spectra and Life of Diatomic Molecules with Free Valencies. E. Miescher. *Helv. Phys. Acta*, 9. 8. *pp.* 693–706, 1936. *In German.*—The absorption spectra of salt vapours are measured immediately after the passage of an electric discharge. In the vapours of BBr_3, $AlCl_3$ and $AlBr_3$, the $^1\Pi$–$^1\Sigma$ bands of BBr, AlCl and AlBr are observed. They disappear within 1/100 sec. after the discharge. The same bands are observed in AlI_3, and give a dissociation energy of 2·9 V for AlI. The $^3\Pi$–$^1\Sigma$ transition in AlI is also found. The concentration of the free radicals is estimated at from 1 to 10 %. No absorption is observed for the vapours of $HgCl_2$, $SiCl_4$ and CCl_4. The binding energies of the halogen atoms in the halides of B, Al and In are discussed. C. B. A.

234. Absorption Spectra of SO_2 and H_2S in the Schumann Region. L. Bloch, E. Bloch and P. Herreng. *Comptes Rendus*, 203. *pp.* 782–784, *Oct.* 26, 1936.—Absorption bands of SO_2 and H_2S are tabulated over the wave-length ranges 1988–1550 Å and 1600–1220 Å respectively. C. B. A.

235. Ultra-Violet Absorption of Coproporphyrin and its Metallic Complexes. M. Paić. *Comptes Rendus*, 203. *pp.* 933–935, *Nov.* 9, 1936.—A solution containing $1·21 \times 10^{-3}$ gm. mol./l of coproporphyrin is employed with NaOH, $NaHCO_3$, HCl, and ether acidified with CH_3COOH. All give a broad band about 4000 Å, which is sharpest and strongest in HCl. The metal complexes (Fe^{+++}, Fe^{++}, Cu^{++}) give a band in the same position and a minimum about 3400 Å, which are strongest and sharpest in Cu^{++} coproporphyrin in ether. The methods of preparing the metallic complexes are given. H. G. C.

236. Absorption Spectra and Association of Tin Halides in Aqueous Solution. H. Fromherz and H. J. Walls. *Zeits. f. phys. Chem.* 178. *Abt.A.* 1. *pp.* 29–36, 1936.—In conclusion of previous work on absorption spectra of halides of the heavy metals in aqueous solution, the following results are obtained for tin: (*i*) With increasing concentration, tin ions and halogen ions associate progressively to form saturated coordinated complex ions, but these are not so stable as for Pb; (*ii*) the position of the absorption bands of the complex depends in a definite way, which is described in detail, on the positions of the bands of the free metal

and halogen ions, and the absorption of the metal ions can be predicted from that of the complex. C. B. A.

237. Optical Behaviour of Dissolved Ions and Structure of Electrolytic Solutions. Part V. G. Kortüm. *Zeits. f. phys. Chem.* 34. *Abt.B.* 3–4. *pp.* 255–274, 1936.—This paper continues previous work [see Abstract 4208 (1936)] on the absorption of light and dispersivity of organic dyestuff ions in aqueous solution, from which it was found that the behaviour depended partly on the effective dispersion forces between the parts of uncharged molecules and partly on the forces of hydration. Accurate optical methods are particularly suitable for establishing the commencement of micelle formation and therewith the transition from ionic-disperse to colloid-like solutions. Measurements over the validity range of the Beer law in aqueous solutions of dyestuffs have revealed relationships between the degree of dispersivity on the one hand and ionic magnitude, number and distribution of hydrophilic groups and steric influences on the other. These results are of importance for the recently discovered connection between degree of dispersivity and the kinetics of the dyeing processes. Experimental details are included in the paper. H. H. Ho.

238. Spectra of Adsorbed Porphyrins. F. Bandow. *Zeits. f. phys. Chem.* 34. *Abt.B.* 5. *pp.* 323–334, 1936.—The absorption and fluorescence spectra of porphyrins adsorbed on organic and inorganic materials are observed. It is shown that they have the same spectral forms as those of solutions of porphyrins, but the detailed structure depends primarily on the nature of the adsorbing substance and also on the solvent from which adsorption takes place. C. B. A.

239. Intensities in the $^3\Pi$, $^3\Sigma$ Band of PH. P. Nolan and F. A. Jenkins. *Phys. Rev.* 50. *pp.* 943–949, *Nov.* 15, 1936.—Measurements of the relative intensities of the lines in the 0,0 band of PH at λ 3400 are given. The band was excited by a h.v. discharge through H_2 and P vapour. The distribution of molecules in the initial states is evaluated by using the sum rule, and is found to correspond to thermal equilibrium at 696° K., not only for the various rotational levels of a given electronic state, but also for the three components of the $^3\Pi$ multiplet. The intensity factors i are tabulated and compared with their theoretical values for $^3\Pi$ (case *a*), $^3\Sigma$ and for $^3\Pi$ (case *b*), $^3\Sigma$. These theoretical factors are given for the first time in explicit form. The observed i factors are in qualitative agreement with theory. For the main branches, they are linear functions of J', with relative values close to those expected for case *b* at all except the lowest J values. For the satellite branches, they increase nearly linearly at low J, but soon reach a maximum and fall off, due to the uncoupling of the spin by the rotation. From the experimental i factors, the sum rule is also verified for the lower states. Authors.

240. Primary Photo-Process in Ionic Crystals. L. M. Schamovskij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 2. *pp.* 57–61, 1936. *In German.*—Various equations for the energies of the first absorption maxima of alkali halide crystals are deduced and discussed. C. B. A.

241. Influence of Pressure on Predissociation. W. Lochte-Holtgreven. *Zeits. f. Physik*, 103. 5–6. *pp.* 395–413, 1936.—The influence of pressure on predissociation spectra is systematically investigated and shown to be divisible into two parts, apparent pressure effects dependent on layer thickness or excitation mechanism of the light source and true

pressure effects which change the transition probabilities of radiationless transitions and consequently affect a change of molecular constants. There are two true pressure effects, disturbance of the potential curves by the fields of neighbouring atoms and " induced predissociation " due to a breaking down of the selection rules. The results of measurements in the S_2 absorption and emission spectra are cited as examples. On the basis of the observations the whole of the first predissociation region extending from 2799 to 2615 Å is interpreted as " induced " predissociation. The upper limit for the work of dissociation of the ground state of S_2 is 4·7 volts. J. E. K.

242. Constitution and Spectra of Porphyrins. Energy-Level Scheme for the Porphyrin Molecule. H. Hellström. *Archiv f. Kem. Min. och Geologie, Stockholm,* 12*B. No.* 13. [6 *pp.*], 1936. *In German.*—On the basis of previously published measurements of absorption and fluorescence spectra a tentative scheme of energy levels for the porphyrin molecule is put forward in the form of a diagram and discussed. L. A. W.

243. Group Theory and Vibrations of Polyatomic Molecules. Jenny E. Rosenthal and G. M. Murphy. *Rev. Modern Physics,* 8. *pp.* 317–346, *Oct.*, 1936.—An entirely mathematical discussion, based on classical mechanics, of the symmetry properties and vibrations of polyatomic molecules. A. H.

244. Empirical Formulæ Relating Equilibrium Vibration Frequency and Distance in Non-Hydride, Di-Atom Nuclei. C. H. D. Clark and J. L. Stoves. *Phil. Mag.* 22. *pp.* 1137–1157, *Dec.*, 1936.—Formulæ suggested by Allen and Longair, Badger, and Clark connecting fundamental vibration frequency and internuclear distance have been tested in respect of their capacity to reproduce experimental internuclear distances for 70 ground and excited electronic states of 33 non-hydride di-atoms. For di-atoms containing one atom of the K period, Clark's formula ($\omega_e r_e^3 n^{\frac{1}{2}} = k - k'$) gives the best results, whilst Badger's recent modification effects no improvement on his original formula. More complex di-atoms require attention to be paid to the electron configurations of the atoms concerned in assigning the period constants, and Clark's formula ($\omega_e r_e^3 n^{\frac{1}{2}} = k_\varphi$) is generally more satisfactory than the other proposals. This formula may therefore be recommended for use in band spectroscopy, following the procedure explained in the paper. AUTHORS.

245. Low Electronic States of Simple Heteropolar Diatomic Molecules. Part I. General Survey. R. S. Mulliken. *Phys. Rev.* 50. *pp.* 1017–1027, *Dec.* 1, 1936.—The three lowest energy states of molecules H_2, M_2, and MH are here deemed more or less analogous and labelled N, T, V ; these are respectively of the types $^1\Sigma^+$, $^3\Sigma^+$, $^1\Sigma^+$. States N, T and V must exist also in all other uni-univalent molecules, *e.g.*, X_2, XY, HX, AgX, MX (M = alkali metal atom, X or Y = halogen atom). The characteristics of the states N, T, V (polarity, ionicness, etc.) are surveyed. Only in H_2 is state T yet known empirically ; N is the normal state always ; V is to be identified with a state known from band spectra in the case of most molecules of the types above named. In molecules containing one halogen atom, there should be an additional low energy group of states (types $^3\Pi$, $^1\Pi$), here labelled the Q group. Various points connected with the approximation of polar diatomic molecule wave functions using atomic orbitals, and using molecular orbitals, are discussed. Difficulties and arbitrariness inherent in the definition of

polarity and ionicness are examined. [See also Abstract 5063 (1934) and following Abstract.] AUTHOR.

246. Low Electronic States of Simple Heteropolar Diatomic Molecules. Part II. Alkali Metal Hydrides. R. S. Mulliken. *Phys. Rev.* 50. *pp.* 1028–1040, *Dec.* 1, 1936.—Some discussion of the nature of the V level in H_2 and M_2 is first given, then the alkali hydrides are taken up. The upper electron state involved in the one well-known band system of each of the molecules LiH, NaH, and KH is a V state. The exceptional form of its potential energy curve (shown by the abnormal band spectrum constants) can be explained satisfactorily if we suppose that the observed N and V curves result from the strong interaction of two zero approximation curves, one of atomic (M·H), the other of ionic (M^+H^-) character. The situation is analysed in detail for LiH. It is shown that the V state of LiH, while of only partially ionic character near its minimum, goes over at somewhat larger r values into the pure ionic (L^+H^-) curve. The N state of LiH is strongly polar near its minimum, but finally goes over into a pair of neutral atoms with increasing r. It is concluded that the "additivity" theorem for homopolar bond energies is not fulfilled in MH (nor in MX; cf. III). This conclusion is forced by the otherwise unaccountably small dissociation energy of diatomic MH. N and V levels of the molecules BeH^+, ZnH^+ and the like are identified. In CuH, AgH and AuH, the presence of d electrons is considered responsible for a lack of close analogy to MH. [See preceding Abstract.] AUTHOR.

247. Emission Spectra of Free Radicals Produced by Photo-Dissociation of Polyatomic Molecules in the Schumann Ultra-Violet. H. Neuïmin and A. Terenin. *Acta Physicochimica,* 5. 4. *pp.* 465–490, 1936. *In English.*—Under the action of Schumann radiation on the vapours of H_2O, CH_3OH, C_2H_5OH, HCOOH, CH_3COOH, CH_3CN, NH_3, N_2H_4 these molecules are dissociated with the liberation of the radicals OH, HCO (?), CN, NH_2 emitting their band spectra. The behaviour of these excited radicals on collisions with H_2, N_2, CO, He is investigated. AUTHORS.

248. Zeeman Effect of Atmospheric Oxygen Bands. R. Schmid, A. Budó and Jolanthe Zemplén. *Zeits. f. Physik,* 103. 3–4. *pp.* 250–262, 1936.—A discussion of the absorption spectra of the O_2 band $^1\Sigma \leftarrow {}^3\Sigma$ at 7600 Å obtained by Zemplén in a magnetic field of 26,000 gauss and a path of 80 cm. The theoretically expected Zeeman effect of the $^3\Sigma$ term with non-negligible triplet splitting is evaluated by means of a number of simplifying assumptions. From the field free triplet term arise threefold $(2j + 1)$ Zeeman components for each K, corresponding to $M = 1, 0, -1$. On account of the width of the absorption lines even without a field it is found that the Zeeman complexes are shifted more than the normal amounts. Photographs and details of the apparatus are given. J. E.

249. Variation with Field Strength of the Zeeman Displacements in Mercury. P. Jacquinot and G. Dupouy. *Comptes Rendus,* 203. *pp.* 779–782, *Oct.* 26, 1936.—New measurements of the Zeeman effect in Hg 4358 have been made under more rigorous conditions in order to confirm the previous observation that the separations for the $^3S_1$ and $^3P_2$ levels were not proportional to the field strength. [See Abstract 4604 (1935).] C. B. A.

250. Influence of a Magnetic Field on the Hydrogen Atom. E. Sevin. *Comptes Rendus,* 203. *pp.* 846–848, *Nov.* 3, 1936.—The effect

of a magnetic field on the relativistic motion of an electron and proton around their common centre of gravity, and its effect on fine structure are examined mathematically. It is shown that the Coriolis force to which the centre of gravity is subjected balances the part of the magnetic force which is due to the orbital eccentricity, and hence the kinetic momentum undergoes only periodic perturbations. It is this peculiarity which gives rise to the anomalous Zeeman effect. N. M. B.

251. Disappearance of Spectral Lines in Strong Electric Fields. W. Fabrikant. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 5. *pp.* 215–217, 1936. *In German.*—The author uses Smurow's theory to calculate the potential gradient necessary to ionise the H atom when the electron is in any level and so bring about the disappearance of (say) the Π components of lines in the Balmer series (H_γ to H_ζ). This agrees reasonably with the experimentally found values, showing that the disappearance of the lines can be explained classically (since Smurow's formula is based on classical assumptions). He disagrees, therefore, with Lanczos' view that the disappearance occurs below the classical value. He agrees that the *weakening* of such components at lower gradients must be regarded as a wave-mechanical affair due to penetration of the potential barrier. A. C. M.

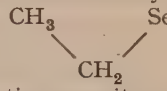
252. Raman Spectra of Sulphur and Phosphorus. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 345–354, *Sept.*, 1936.—The polarisations of Raman lines of S and P are measured, using S dissolved in CS_2, and molten P, and exposures without polarising apparatus were made for the Raman spectra of crystalline rhombic S and molten S at 115°. The P results are consistent with a tetrahedral model for the molecule. The S molecule is considered on the basis of X-ray measurements, and the present results) to have a symmetrical puckered ring made up of two squares of four atoms each, one square placed at 45° with respect to the other. To explain the strong infra-red absorptions, the neighbouring atoms in each plane are assumed to be connected by coordination bonds which give rise to electric dipoles causing absorption. The well-known changes of S on heating are described in terms of the molecular structure here proposed, and an explanation sought. A. C. M.

253. Raman Effect in Electrolytes. H. J. Bernstein, R. G. Romans, O. H. Howden, and W. H. Martin. *Roy. Soc. Canada, Trans.* 30. *Sect.* III. *pp.* 49–64, *May*, 1936.—The study of solutions of a number of electrolytes shows that those dissociating into monatomic ions give no Raman effect and in the case of those with complex ions the effect is due to the ion. The variations with concentration of the Raman spectra of H_2SO_4, HNO_3, and CCl_3COOH are due to changes in the degree of hydration, c.f. the crystals of various hydrates of $Sr(NO_3)_2$. Further in a series of compounds in which the O–H bond changes from covalent to electrovalent (NaOH . . . H_2O . . . HNO_3) the Raman line 3500 cm.$^{-1}$ weakens, broadens, and finally disappears. Covalent and electrovalent bonds are extreme types and all intermediate types occur. No electrovalent bond gives rise to a Raman spectrum and the effect cannot be used for measuring electrolytic dissociation. H. G. C.

254. Optical Examination of Indian Oils. Part II. Raman Effect. C. V. Jogarao. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 459–462, *Oct.*, 1936.—Raman frequencies obtained with the oils previously studied [see Abstract 5530 (1936)] are characteristic of known structural features such as the -C-C-, -C-O-C- and -C = C- linkages. The last-named linkage

was not found in ghee (butter from buffalo-milk), thus establishing one of two alternative formulæ previously suggested. L. V. C.

255. Raman Spectra of Amines and Methylated Ammonium Ions. J. T. Edsall. *Science*, 84. *pp.* 423–424, *Nov.* 6, 1936.—Comparison is made of the Raman spectra of such groups as NH_3Me, NH_2Me_2, NH_3Et, $NHMe_3$, NMe_4, with those of ethane, propane, isobutane, tetramethylmethane, tertiary butyl alcohol, since for example NH_4^+ is analogous (from the electronic point of view) to CH_4. This analogy is found to exist between corresponding compounds in the two lists given above, and expectations from the structures assumed are borne out in the spectra. The CN^+ bond is somewhat stronger than the C-C bond. Free amines corresponding to most of the NH_4 salts have been studied in aqueous solution. Free primary and secondary amines give one or two strong lines between 3,300 and 3,400 cm.$^{-1}$ presumably due to the un-ionised N–H linkage; the corresponding NH_4 salts in which the amino-group has acquired a proton, show no Raman lines above 3,050 cm^{-1}. Similarly the Na salts of glycine and alanine give strong lines near 3,300 cm.$^{-1}$ while the isoelectric amino-acids shown no lines above 3,030 cm^{-1}. It is concluded that the amino-group in glycine and in alanine must be electrically charged. A. C. M.

256. Raman Spectra and Structure of Methyl and Ethyl Selenides. P. Donzelot. *Comptes Rendus*, 203. *pp.* 1069–1070, *Nov.* 23, 1936.—The above two substances were investigated in the infra-red and Raman effect. For $Se(CH_3)_2$ were obtained in the Raman effect several frequencies $>$ 1000 cm^{-1}. attributed to the methyl group. Below this limit were two lines, polarised (236 cm^{-1}. attributed to the deformation oscillation), and 587 (attributed to the symmetric oscillation) and one line, depolarised, 602 cm^{-1}., attributed to the antisymmetric oscillation. Assuming the CH_3 groups act as a block, force-constants are worked out, and the angle subtended by the CH_3 groups at the Se atom is 99° 30′. The infra-red vibrations are mainly combination frequencies. For $Se(C_2H_5)_2$ a plane-model  is adopted, and the groups are regarded as acting as units. The low frequencies are 276, 556, and 579 cm^{-1}. The first of these is regarded as the deformation oscillation. Using the values of the forces from the methyl compound, two frequencies are calculated as 583 and 568 cm^{-1}. Two other frequencies are expected about 990, one depolarised, the other polarised. Two such are found at 960 and 1045 cm^{-1}. A. C. M.

257. Raman Spectra of N_3H and C_3O_2. W. Engler and K. W. F. Kohlrausch. *Zeits. f. phys. Chem.* 34. *Abt.B.* 3–4. *pp.* 214–224, 1936.—Raman spectra of N_3H and C_3O_2 were obtained using the micro-arrangement of Dadieu. The force-constants are evaluated from the spectra, assuming for the first substance that the N atoms are in line, and for the second that all the atoms are in line. It is concluded that the spectra satisfy the formulæ H . N : N ⋮ N and O : C : C : C : O. A. C. M.

258. Raman Spectrum of Ketene. H. Kopper. *Zeits. f. phys. Chem.* 34. *Abt.B.* 5. *pp.* 396–401, 1936.—An arrangement is described whereby Raman spectra may be photographed for liquids at low temperatures. The vessel is surrounded by a stream of alcohol previously cooled in liquid air and is further equipped with a vacuum mantle and a mantle for water or filter-liquid. The Raman spectrum of ketene is photographed at a

temperature between − 80° and − 90° C. and the Raman frequencies are recorded and discussed. The values are in satisfactory agreement with those to be expected from the formula $H_2C = C = O$. L. A. W.

259. Raman Spectra of Sulphur and Phosphorus. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 414–418, *Oct.*, 1936.—Existing theories of the origin of discrete Raman lines in the solids in place of wings accompanying the Rayleigh line in liquids are reviewed. An intense sharp line at 36 cm^{-1}. has been reported for solid P which broadens to a depolarised wing in the liquid state. This frequency agrees with the frequency of vibration of the crystal lattice calculated from the melting point and therefore owes its origin to the latter. The Raman line at 88 cm^{-1}. of rhombic S appears as a weak diffuse depolarised line in liquid S at 80 cm^{-1}. and is also attributed to lattice vibrations. Objections for assigning these lines either to Pauling rotation or to intermolecular oscillations of polymerised groups are indicated. AUTHOR.

260. Optical Excitation by Corpuscular Collisions. K. Gailer. *Zeits. f. Physik*, 103. 5–6. *pp.* 303–314, 1936.—An impact model, originated by Döpel, which has been previously applied with success to the explanation of the effects of a collision between two corpuscles, is here used for the explanation of the effects of bombarding Mg with fast He or H atoms. In this model the reciprocal action between the parties to the collision is taken as a function of the transferable energy, which, in turn, is composed of the translational energy of the valency electrons of the impacting particles, and a fraction of the kinetic energy of the atoms ; this fraction being dependent on the masses and binding energies of both parties to the impact. Experimental results are given for the excitation of Mg by He and H, in which the arc and spark lines of Mg are excited but neither the He nor the H lines are excited. These results along with the results of other workers for the excitation of He by K and by K^+ are discussed and qualitatively explained using the Döpel impact model. G. O. B.

See also Abstracts 2, 19, 40, 72, 163, 164, 208, 300, 327.

VISION.

261. Physical Definition of Subjective Brightness. A. Kühl. *Zeits. f. techn. Physik*, 17. 11. *pp.* 439–441, 1936. *Phys. Zeits.* 37. *pp.* 865–867, *Dec.* 1, 1936.—The author, from known data on threshold brightness and effect of glaring brightness, derives equations which purport to express numerically the subjective brightness of a surface of known area and known physical brightness when the area is surrounded by an extended field of known physical brightness. Another equation gives its numerical position in the black-white scale. The equations apply to uncoloured fields. J. W. T. W.

X-RAYS.

262. Repetition of the Bothe-Geiger Experiment. W. E. Burcham and W. B. Lewis. *Cambridge Phil. Soc., Proc.* 32. *pp.* 637–642, *Oct.*, 1936.—A repetition is made, with the introduction of electrical counting methods, of the experiment of Bothe and Geiger on the simultaneous production of a scattered quantum and of a recoil electron in the scattering of X-rays. Evidence is obtained that such coincidences do actually occur, in agreement with the results of the original experiment, and with the Compton theory of scattering. AUTHORS.

263. Scattering of X-Rays by a Spinning Electron. A. H. Compton. *Phys. Rev.* 50. *pp.* 878–881, *Nov.* 15, 1936.—A theory based on classical electrodynamics is given for X-ray scattering by an electron which is spinning and has a magnetic moment. The radiation scattered by such a magnetic doublet is found to be almost completely unpolarised. This scattering is negligible for ordinary X-rays but should comprise a major part of the scattering for hard γ-rays. The rays scattered by one electron should be incoherent with those from every other. This magnetically scattered radiation is similar in properties to that described by the added term of the Klein-Nishina quantum theory of scattering. The two theories differ in the distribution of scattered radiation with angle. The classical interpretation of Klein and Nishina's added terms may be considered to be scattering due to electron spin. C. J. B. C.

264. Characteristics of the Compton Modified Band. P. Kirkpatrick, P. A. Ross and H. O. Ritland. *Phys. Rev.* 50. *pp.* 928–935, *Nov.* 15, 1936.—The shapes of Compton modified bands, which have been calculated for all scattering elements from H to A, are found to vary periodically with atomic number, atoms with one valence electron being characterised by sharp, narrow lines while atoms with completed electron shells produce broad bands. Experimental results, though incomplete, confirm these variations except as to absolute breadth. Variation of scattering angle has only a second-order effect on the observational breadth of wide modified bands. To an accuracy of 10 % the intensity ratio of modified to unmodified radiation from graphite scatterers is found to agree with the predictions of the Wentzel-Waller theory of scattering by bound electrons. Previous measurements showed the magnitude of the wave-length shift of the maximum in the modified band to be less than that given by the Compton equation, but it is now argued that present theory predicts a still smaller shift. C. J. B. C.

265. Auger Effect for the L Level of Xenon and Krypton. J. C. Bower. *Roy. Soc., Proc.* 157*A*. *pp.* 662–667, *Dec.* 2, 1936.—An investigation of the efficiency of emission of L-series fluorescent radiation from Xe and Kr using an expansion chamber is described. A statistical analysis of some 700 tracks in the case of Xe and 600 in the case of Kr gave values for the efficiency of 20 % and 8 % respectively. The results are compared with those of previous workers. [See Abstract 769 (1935).] AUTHOR.

266. Kα Satellite Lines for Elements Zn(30) to Pd(46). C. H. Shaw and L. G. Parratt. *Phys. Rev.* 50. *pp.* 1006–1012, *Dec.* 1, 1936.—With a two-crystal spectrometer, ionisation curves of the K$\alpha_{3,4}$ group of X-ray satellite lines have been recorded for elements Zn(30) to Pd(46). In this satellite group are found four component lines for elements $30 \leq Z \leq 33$, three components for $34 \leq Z \leq 40$ and two components, α_3' and α_4, for $41 \leq Z \leq 46$. The wave-length position, relative intensity, and line width at half-maximum intensity of each component has been measured. A sharp and anomalous decrease (with increasing Z) in the total satellite intensity relative to the α_1 intensity is found in the region of Y(39). Curious and anomalous intensity relations are also found among the individual satellite components. AUTHORS.

267. X-Ray Levels and Atomic Constants. Part II. H. R. Robinson. *Phil. Mag.* 22. *pp.* 1129–1136, *Dec.*, 1936.—The latest results obtained with the magnetic spectrometer indicate that $e/m_0 \times e/h \times \rho = 1{\cdot}277_4 \times 10^{24}$, where ρ is the ratio of the true to the conventional Moseley-Siegbahn wave-length of an X-radiation. If recent and apparently

reliable values are assigned to e/m_0 and ρ, this result leads to a value of e/h which agrees well with that deduced from the Rydberg constant and less well with the values obtained in recent experiments on the inverse photoelectric effect. [For Part I see Abstract 355 (1935).] AUTHOR.

268. X-Ray K-Fluorescence Yield. I. Backhurst. *Phil. Mag.* 22. *pp.* 737–752, *Nov.*, 1936.—The K-fluorescence yield coefficient w_K is determined for nine elements of atomic number Z between 42 and 56, using apparatus and methods similar to those previously described for the measurement of scattered X-rays [see Abstract 1198 (1934)]. The results are well represented by $w_K = 1-1/(1+bZ^4)$, where $b=1\cdot035\times 10^{-6}$. This corresponds to considerably higher values of w_K than those suggested by recent approximate calculations based on wave-mechanics theory. Comparison is made with results due to other authors, and for $Z<42$ the average of the results so far available is in reasonably good agreement with the equation given above. AUTHOR.

269. Efficiency of Fluorescent X-Radiation. W. Crone. *Ann. d. Physik*, 27. 5. *pp.* 405–420, *Nov.*, 1936.—A determination is made of the efficiency of emission of fluorescent radiation from various gases of low atomic number when irradiated by the K-radiation of Al. The gaseous atoms studied are Ne, N, O and C, the latter being used in the form of propane. It is shown that the fluorescent radiation is very weak and hence a sensitive method of recording is necessary; a Geiger point-counter is employed. A detailed description of the apparatus and experimental procedure is given. Particular care is paid to the corrections to be applied to the experimental data, especially for the effects of absorption of the radiation, and to the method of presenting the results. The measurements are given as efficiencies relative to the value for Ne as standard. By the use of some earlier measurements, absolute values of the efficiencies are obtained. The results agree well with a theoretical curve obtained by Wentzel, which, for low atomic numbers Z, as here, is of the form Z^4.

G. O. B.

See also Abstracts 45, 113, 162, 393, 394, 395.

HEAT.

CALORIMETRY.

270. Physical Properties of Solid and Liquid Helium. J. Satterly. *Rev. Modern Physics*, 8. *pp.* 347–357, *Oct.*, 1936.—The physical properties of solid He and the two liquid forms are reviewed, the major portion of the results included in the paper being from the Kamerlingh Onnes Laboratory in Leiden. The pressure-temperature diagram of liquid and solid He is described in some detail, with remarks on the triple-point and the λ-line. Data on the variation of density with temperature and pressure for the two forms of liquid He are given, and also their coefficients of expansion. Under the heading of He calorimetry the results for latent and specific heats are quoted. The latent heat of transformation from He liquid I to He liquid II is extremely small, in all probability zero. The thermal conductivity of liquid I shows no peculiarities having a conductivity 6×10^{-5} cal./sec./cm.^{2}/°C., while the liquid II has a thermal conductivity of 190 cal./sec./cm.^{2}/°C., and is in fact the best thermal conductor known. The electrical conductivities of the two liquid forms are nearly equal however. Measurements of several other properties are also included in the review. C. J. B. C.

***271. Specific Heats of Ammonium Nitrate Solutions. F. T. Gucker, Jr., F. D. Ayres and T. R. Rubin.** *Am. Chem. Soc., J.* 58. *pp.* 2118–2126, *Nov.*, 1936.—The paper describes in some detail the construction and operation of a new modification of the twin calorimetric apparatus for measuring specific heats. Special electrical heaters, with resistances variable in small stages, are used to supply energy proportional to the heat capacity in each calorimeter, and the resistance ratio is measured during the experiment. From these data the required specific heat is calculated. The results for a number of ammonium nitrate solutions are given in tabular form, and an equation is evolved which gives the apparent molal heat capacity as a function of the volume concentration. E. H. D.

***272. Specific Heat of Silver, Nickel, β-Brass, Quartz Crystals and Quartz Glass. H. Moser.** *Phys. Zeits.* 37. *pp.* 737–753, *Nov.* 1, 1936. *From the Reichsanstalt.*—The true specific heats of solid bodies at high temperatures are only known with a small degree of accuracy. In most calorimetric methods the value obtained is the mean value over a large temperature range, and the true value can only be evaluated if the variation with temperature is small. The present paper describes a refined method using the " primary heat supply " method of Perrier and Roux. The measurements are carried out under what are practically adiabatic conditions. A silver calorimeter is used, and its construction, erection and use are described in considerable detail. Owing to the difficulty of maintaining a good vacuum at high temperatures, the experiments are carried out in an atmosphere of A at reduced pressure. The absolute accuracy is claimed to be $\pm$ 0·5 %. The results are given in tabular and graphical form, and are discussed in relation to other work on the subject. The small variation of the specific heat of Ag with temperature makes it possible to deduce a formula for the value of the specific heat at constant

pressure and for that at constant volume, but the other materials show transformation points. E. H. D.

273. Molecular Heat of Methane in Solid CH_4–Kr Mixtures. A. Eucken and H. Veith. *Zeits. f. phys. Chem.* 34. *Abt.B.* 3–4. *pp.* 275–299, 1936.—From the experimentally determined molecular heats between 12° and 80° for a number of CH_4–Kr mixed crystals, the molecular heat of CH_4 in these mixed crystals is deduced and so the heat of rotation of CH_4. Pure CH_4 shows anomalous molecular heats (or heat of rotation) at 20·6°, as can be seen already when only small amounts of Kr are present. When the Kr content is between 30 and 50 % the heat of rotation increases with the temperature; at a concentration of Kr of 72 % there is again a weak maximum at 22°. The results obtained are in agreement with those of other workers, namely, that in the solid state the three modifications of CH_4 can change directly into one another. A novel view on free rotation in the solid state is submitted. J. K.

See also Abstracts 280, 297, 298, 302.

CONDUCTION.

274. Thermal Conductivity of Liquids. J. F. D. Smith. *A.S.M.E., Trans.* 58. *pp.* 719–725, *Nov.*, 1936.—New data on the thermal conductivities of several liquids are presented in this paper. A compilation of these values, together with those of previous experimenters, yields a large list of liquids the thermal conductivities of which have been determined. This list should be of interest to many engineers and physicists. An analysis of theoretical and empirical equations for predicting thermal conductivities of liquids is also included. AUTHOR.

275. Optical Comparison Method for the Determination of the Thermal Conductivity of Transparent Liquids. T. Klassen. *Techn. Phys., U.S.S.R.* 3. 9. *pp.* 832–837, 1936. *In German.*—In a previous paper a method was described whereby the thermal conductivity of a liquid could be determined from the variation of the refractive index with temperature. It is now shown that if a beam of light is passed through a liquid in which there is a temperature gradient perpendicular to the beam, the temperature gradient can be expressed in terms of the deviation of the light beam. A formula is deduced, and suitable apparatus for the purpose is described. It is necessary to have a liquid of known thermal conductivity coefficient. The formula involves the refractive index, and the coefficient of cubical expansion. Examples, which show the accuracy of the method, are given. E. H. D.

276. Heat Conduction by Rarefied Gases. Part II. Thermal Accommodation Coefficient of He, Ne, H_2 and N_2 on Glass at 70–90° K. W. H. Keesom and G. Schmidt. *K. Onnes Lab., Leiden, Comm. No.* 245*b*. *Physica*, 3. *pp.* 1085–1092, *Dec.*, 1936. *In English.*—These measurements form part of a series of investigations on heat conduction by rarefied gases, *viz.*, He, H_2, Ne and N_2 at 0° C., 70–90° K. and 14–20° K. Some points of view in relation to these experiments are discussed. The accommodation coefficient ($a_{1,\infty}$) with regard to glass appears to increase with decreasing temperature, to a degree which appears to be connected with the critical temperature. From these experiments considered in connection with measurements on adsorption it follows: (1) $T < T_{crit.}$: adsorption, $a_{1,\infty} = 1$; (2) $T > T_{crit.}$: no measurable adsorption; at least for a certain temperature range from the critical

temperature upwards a rather large increase of a_1, with decreasing temperature, which can be conceived as an indication of approaching adsorption. [For Part I see Abstract 3729 (1936).] AUTHORS.

277. Effect of Carbon Dioxide on the Thermal Conductivity of Cotton Wool. Y. Takamura. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 491–496, *Oct.*, 1936. *In English.*—In a previous paper [see Abstract 4770 (1936)] a method was described whereby the effect of H_2 on the thermal conductivity of cotton wool could be investigated. The same apparatus was used for the present experiments. Values of the ratio $K_{(CO_2)}/K_{(Air)}$ are plotted against the percentage of CO_2 and give a fairly good straight line. Values for the conductivity of the CO_2-cotton wool mixture are deduced together with values for the conductivity of the cotton wool phase. E. H. D.

See also Abstracts 50, 79, 111, 270, 280, 284, 297.

CONVECTION.

278. Convection and Variation of Temperature near a Hot Surface. Part I. M. K. Paranjpe. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 423–435, *Oct.*, 1936.—The paper discusses the formation of the dark or dust-free layer in the space between a hot surface (above) and a cold surface (below). The variations of the dark layer (1) with distance between the surfaces when the temperatures of the two surfaces are kept unaltered and (2) with the temperature gradient when the distance is kept constant at 3·5 mm. are studied. It is shown that when the distance between the two surfaces is less than 4 mm. the whole space is occupied by the dark layer. If smoke is introduced into this space it travels from the hot to the cold surface with a velocity proportional to the temperature gradient. The excess of pressure associated with the velocity of the particle is calculated. AUTHOR.

279. Optical Method of Investigating the Temperature Field Around a Cylinder Due to Forced Convection. V. Joukovsky and A. Kirejew. *Techn. Phys., U.S.S.R.* 3. 8. *pp.* 754–766, 1936. *In German.*—An optical method of the schlieren type is described in which the usual slit is replaced by a number of apertures in the form of a grating. This arrangement produces a series of dark bands around the surface under investigation, their spacing depending on the temperature field at the point concerned. It is shown how the method can be applied to give the actual temperature distribution in the air. Results are given for various directions around a cylinder when exposed to a wind at right angles to the axis. The experiments cover Reynolds numbers ranging from 3800 to 14,000. R. W. P.

***280. Calorimetry of a Hot Wire. H. Duculot.** *Assoc. Ing. El. Liège, Bull.* 16. *pp.* 204–219, *Aug., and pp.* 221–233, *Sept.*, 1936.—A calorimeter is described in which measurements are made of the heat communicated to the air from electrically-heated wires composed of a large number of different metals. The wires are all of the same size and each is heated for periods of 15 sec. by steady currents whose values are gradually increased until fusion occurs. The energy supplied is measured and the proportion lost by radiation and convection determined in each experiment. Tests are also made in which the length of wire is gradually increased. In this way information is obtained as to the loss by conduction to the electrodes, and the length of wire needed before such loss

becomes negligible is determined for each material. For the purpose of obtaining information as to the additional loss occurring from fuse wires in contact with insulators tests are carried out with various lengths of the wire surrounded by discs of mica. As the length in contact with mica is increased the time taken for fusion to occur when a fixed current is passed increases. R. W. P.

281. Theoretical Dimensions of Bénard Cellular Vortices. P. Vernotte. *Comptes Rendus*, 203. *pp.* 985–987, *Nov.* 16, 1936.—The paper, which is a continuation of two previous papers [see Abstract 4773 (1936)] deals with the stability of a layer of fluid heated from below. By taking different forms for the disturbance (*i.e.*, for the velocity components) theoretical calculations can be made for cellular vortices of various shapes, *e.g.*, squares, rectangles, isosceles right-angled triangles, equilateral triangles, hexagons, etc. For each shape there is an infinite sequence of possible dimensions. Comparisons are made of Bénard's experiments with the theoretical result which most nearly fits. The theory applies to a layer with a free surface. Concluding remarks are made about a layer between parallel walls. S. G.

DILATATION.

282. Thermal Expansion of Lead-Antimony Alloys. P. Hidnert. *Bureau of Standards, J. of Research*, 17. *pp.* 697–708, *Nov.*, 1936.—This paper gives the results in graphical form of an investigation of the linear thermal expansion of cast Pb-Sb alloys containing 2·9–98·0 % of Sb, between −12° and 200° C. In most cases the heating curve lies above the cooling curve, and these differences are said to be due to the chemical composition or to variations in the casting technique. Equations are given which show the relation between the proportion of Sb and the thermal expansion, for different ranges of temperature. It is shown that these constants cover a very wide range and alloys can be found which have the same coefficient of expansion as Fe, Ni, Au, Cu, Ag, Al, Mg, etc. The apparatus used was described in an earlier paper. E. H. D.

See also Abstracts 50, 270, 275, 297.

MELTING AND BOILING POINTS.

283. Freezing Points of the Ternary System Glycerol-Methanol-Water. H. B. Feldman and W. G. Dahlstrom, Jr. *Indust. and Engin. Chem.* 28. *pp.* 1316–1317, *Nov.*, 1936.—Freezing points were obtained by a " melting-point " method (temperature at which last crystals disappear) for systems containing methanol 0–50 %, glycerol 0–70 % and water 30–100 %. The results, covering freezing points down to −50° C., are presented in the form of a triangular coordinate diagram. The final selection of an anti-freeze mixture will depend upon considerations of vapour pressure and viscosity. L. V. C.

See also Abstracts 108, 297, 301.

TEMPERATURE, MEASUREMENT OF.

***284. Self Oscillation in a Retroacting Thermal Conductor. L. B. Turner.** *Cambridge Phil. Soc., Proc.* 32. *pp.* 663–675, *Oct.*, 1936.—Attempts to avoid hunting in the thermostatic control of a chamber by substituting an amplifier-like relation between the slave and master coils, (*i.e.*, the slave coil current a continuous function of the master coil temperature), for the usual relay-like arrangement showed that if the control

sensitivity was sufficiently increased, violent thermal oscillation supervened. The frequency of the oscillation was stable, but had no relation to any natural frequency of the electrical system. A simple model in the form of a metal bar was then constructed in which thermal oscillation could also be induced at a critical value of the control sensitivity. This case is analysed mathematically, and it is found possible to calculate this critical value, and also the period of the oscillation. The calculated values are of the same order as those obtained experimentally. Observations are also made as to the nature of the thermostatic control when the critical value is exceeded. R. W. P.

***285. Adjustable Sensitive Thermoregulator. J. Y. Yee and R. O. E. Davis.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *p.* 477, *Nov.* 15, 1936.—The thermoregulator described is made of glass and is filled with Hg. The surface is increased by having indentations extending inwardly and upwardly into the body, the glass wall here being very thin. Adjustment is by means of a piston working in a glass tube of uniform diameter, and the electrical contacts are of nichrome wire. The range is 20° C. to 100° C., and the accuracy up to 40° C. is $\pm$ 0·001° C. for long periods, in a large bath. A slight modification of this instrument is also briefly described. E. H. D.

***286. Humidity Control Device for Ovens. C. T. Webster.** *Journ. Sci. Instruments*, 13. *pp.* 412–413, *Dec.*, 1936.—The principle of the wet and dry bulb thermometer has been employed for controlling the humidity inside an oven. A simple arrangement is described by means of which the humidity can be maintained at any desired value between 90 and 25 % R.H. within $\pm$ 1 % over a range of temperatures. AUTHOR.

***287. Thermionic Relay Circuit for A.C. or D.C. Supply for Use With a Thermoregulator. P. L. Temple.** *Journ. Sci. Instruments*, 13. *pp.* 414–415, *Dec.*, 1936.—An improved form of valve relay is described for control of a thermoregulator, or any other type of switch which passes only a very small current. It is reliable, compact, and easily constructed, and is operated from the mains. [See Abstract 255 (1936.)] AUTHOR.

See also Abstract 279.

THERMOCHEMISTRY.

288. Dissociation of Hydrogen by Tungsten. G. Bryce. *Cambridge Phil. Soc., Proc.* 32. *pp.* 648–652, *Oct.*, 1936.—The dissociation of hydrogen by a hot W filament is studied under conditions such that all the H produced is effectively removed by reaction with molybdenum or tungsten oxide. The rate of production of H is many times greater than was inferred from earlier work. With the W at constant temperature the rate of dissociation is proportional to the square root of the pressure. A formula is given for the rate of production of H atoms per sq. cm. of the W per sec. [See following Abstract.] AUTHOR.

289. Mechanism of Production of Atomic Hydrogen by Hot Tungsten. J. K. Roberts and G. Bryce. *Cambridge Phil. Soc., Proc.* 32. *pp.* 653–656, *Oct.*, 1936.—The fact that the rate of production of H at a W surface at a given temperature is proportional to the square root of the H_2 pressure means either that the important process is the evaporation of atoms from an adsorbed film which over the whole range of experimental conditions is sparsely occupied, or that the production of atoms is in the main due to a process in which a H_2 molecule strikes a

bare W atom in the surface, one atom being adsorbed and the other evaporating and the surface being almost completely covered over the whole range of experimental conditions. Either process leads to a temperature variation in the rate of atom production in agreement with experiment. A definite decision between the two processes cannot yet be made. [See preceding Abstract.] AUTHORS.

290. Thermal Exchanges in Metallic Transformations. H. v. Steinwehr and A. Schulze. *Phys. Zeits.* 37. *pp.* 753–757, *Nov.* 1, 1936. *Zeits. f. Metallkunde*, 28. *pp.* 347–349, *Nov.*, 1936.—For the magnetic transformation in a Ni cylinder of mass 26·7 kg. (with 0·90 % impurities), a value of $0{\cdot}6_5 \pm 0{\cdot}06$ cal./gm. is obtained. A very small thermal reaction is observed at a temperature about 100° C. below the Curie point, for which no explanation is offered. [See also Abstract 3560 (1935).] H. J. H. S.

291. C-C-Bond in Hexaphenylethane. E. Hückel. *Zeits. f. phys. Chem.* 34. *Abt.B.* 5. *pp.* 335–338, 1936.—The author criticises the work of Bent and his collaborators [see Abstract 1261 (1936)], who state that there should be a decisive steric effect to account for the weakening of the C-C- bond in hexaphenylethane, besides the gain in resonance energy of the double bond electrons due to dissociation, and have determined its magnitude from the heat of hydrogenation. It is now shown that such a steric effect and other contingent effects cannot be separated experimentally from the resonance effect. H. H. Ho.

292. Combustion of Gases Exploding at Low Pressures. P. Tauzin. *Ann. de Physique*, 6. *pp.* 575–662, *Nov.*, 1936.—This paper deals with the combustion of mixtures of H_2 and O_2 in tubes of silica or of glass heated to about 500° ; the pressure of these mixtures being at the moment of explosion of the order of a few cm. of Hg. Reference is made to the work of Hinshelwood and Semenoff who showed that for a given wall temperature T there are two limiting pressures, p_1 and p_2, between which the mixture does not explode. Part I deals with the influence of the volume of the products of combustion, the addition of an inert gas to the explosive mixture, and the ratio of H_2 to O_2 in the mixture, on these two limiting pressures p_1 and p_2. Part II deals with the photography of spectra emitted by the flame of combustion. Part III is concerned with the various theories which have been proposed, particularly that of Hinshelwood and Semenoff. Part IV shows that in certain methods of measuring the temperature of explosion at atmospheric pressure, the gas is in reality exploded at low pressures and not as previously believed at atmospheric pressures. J. K.

See also Abstracts 108, 233, 298 302.

THERMODYNAMICS.

293. New Equation of State. J. Weichherz and R. Gouguell. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 3. *pp.* 121–125, 1936. *In German.*—Based on measurements of the fluidity of binary mixtures, a new equation has been derived by means of graphic analysis, which is a general equation of state for gaseous, liquid and solid systems, *viz.*: $(\phi_1-\phi)/x=\sqrt{\phi_1'\ \phi'}$ with $1/(\phi_1-\phi)=-(1-x)/x\phi_1'+1/(\phi_1-\phi_2)$, where ϕ, ϕ_1 and ϕ_2 are the fluidities respectively of the mixture and of the components of molecular functions $1-x$ and x. The theoretical derivation and analysis of the equation indicated that the ideal gas law represents a

first approximation, while the new equation is a second approximation. The new equation represents all changes of state of material systems when no maximum, minimum or transition point occurs; also that the volume as well as other variables and functions at $p = \infty$ do not disappear but possess finite values. It is also shown how molecular diameters can be evaluated and that the data agree with those found by other methods. The equations confirm the viewpoint that the exact description of physical phenomena may only be made successfully *via* the consideration of changes of properties in material systems and not of absolute properties. H. H. Ho.

294. Boyle Temperature and a General Equation of State. G. Woolsey. *Am. Chem. Soc., J.* 58. *pp.* 2229–2231, *Nov.*, 1936.—It is shown that the use of the Boyle temperature, *i.e.*, that at which $(\partial PV/T/\partial P)_T = 0$, has resulted in a modification of the form of the general equation of state wherein the logarithmic term is a function of T, and that it has simplified considerably the determination of the constants of the equation. Using the critical point, the ideal gas value at low pressure, two points on the critical isotherm at high pressure, the Boyle temperature, one point in the liquid phase and the second term maximum at the critical point, an equation is found which fits fairly closely at the eight other widely divergent points which were tested. H. H. Ho.

295. Complete Equation of State of One, Two and Three-Dimensional Gases of Hard Elastic Spheres. L. Tonks. *Phys. Rev.* 50. *pp.* 955–963, *Nov.* 15, 1936.—For the linear gas, the phase integral is integrable and by using the virial equation is found to be $fl = NkT/(1-\theta)$ f being the force and l the length of the gas, N the total number of atoms and θ the fraction of gas length occupied by the atoms themselves. For the plane gas, Boltzmann's method of correcting the virial is used for low θ, the fraction of the surface which would be covered in close triangular packing, giving $\tau a = NkT\ (1 + 1{\cdot}814\,\theta + 2{\cdot}573\theta^2 + \ldots)$ where τ is surface tension and a the area of the gas. For θ nearly unity it is found that $\tau a = NkT/(1-\theta^{\frac{1}{2}})$. The adsorption isotherm is derived and compared with those for films in which the adatoms occupy fixed positions on the surface. In three dimensions the same treatment gives $pv = NkT(1 + 2{\cdot}962\theta + 5{\cdot}483\,\theta^2 + \ldots)$, and for N nearly unity $pv = NkT/(1-\theta^{\frac{1}{4}})$. R. W. P.

296. Quantum Theory of the Equation of State at Low Temperatures. L. Gropper. *Phys. Rev.* 50. *pp.* 963–974, *Nov.* 15, 1936.—The quantum formulæ for the second virial coefficient B are derived, for the case of Boltzmann, Einstein-Bose and Fermi-Dirac statistics. It is shown how these formulæ may be expressed in terms of the phases of the Schrödinger wave function. For low temperatures the expression for B is developed in a power series of T, the temperature, which gives formal agreement with the experimental formula in the case of He. Using this series development a potential is fixed to fit the data. The potential agrees with the Slater-Margenau potential in the region where the latter is valid. AUTHOR.

297. Liquid State. Part I. E. Bauer, M. Magat and M. Surdin. *J. de Physique et le Radium*, 7. *pp.* 441–447, *Nov.*, 1936.—By adopting a form of reduced variable, similar to those employed in the case of gases, it is shown that the static properties of most liquids can be expressed as functions of the reduced temperature $\theta = (T - T_f)/(T_c - T_f)$, where T_c = critical temperature and T_f = triple point. This holds for the reduced, *i.e.*, ratio of property at T to property at the triple point, molecular volume, reduced compressibility and reduced surface tension. The

specific heats of monatomic liquids also appear to conform to the rule, but dynamic properties such as viscosity and thermal conductivity do not. R. W. P.

***298. Thermal Hysteresis of Methane Transformation at 20·4° A. A. Eucken and E. Bartholomé.** *Göttingen Nachrichten, Fachgruppe II*, 2. 3. *pp.* 51–64, 1936.—Changes in state differ from normal allotropic transformations in that (1) there may be little or no change in the crystal structure, and (2) any heat liberated may not be freed at a particular temperature, but may be given up over a finite temperature range. This will cause abnormalities in the specific heat over this range. The present paper deals with the properties of methane in the neighbourhood of 20·4° Abs., from this point of view. The hysteresis loop is considered in relation to the purity of the methane, the velocity of heating and cooling, etc. Suitable apparatus is described for the necessary measurements, and the method of purification of the material is given briefly. The whole matter is also considered from a theoretical standpoint, and hysteresis curves are deduced. E. H. D.

299. Thermodynamic Study of the Lead-Bismuth System. H. S. Strickler and H. Seltz. *Am. Chem. Soc., J.* 58. *pp.* 2084–2093, *Nov.*, 1936.—The e.m.f.s are systematically measured in three types of concentration cell, Pb(liq.)|$PbCl_2$ in molten LiCl–KCl|Pb–Bi alloy (liq.); Pb(solid)|PbA_2 in molten NaA|Pb–Bi alloy (liq. and solid). From thermodynamic calculations phase boundaries are fixed as α 36·5 atomic % Bi, $\beta < 0{\cdot}5$ atomic % Pb. The eutectic is placed at 54·7 atomic % Bi at 125° C. From an entropy standpoint the molten alloys behave as ideal solutions. To explain their results the authors introduce γ and $\gamma + \alpha$ fields and claim to have detected a peritectic reaction at 184° C. between 22 % and 37 % Bi (atomic). D. R. H.

300. Chemical Constant and Thermodynamic Potential of Gaseous NO_2 and Equilibrium Constant of the Reaction $2NO + O_2 = 2NO_2$. H. Zeise. *Zeits. f. Elektrochem.* 42. *pp.* 785–789, *Nov.*, 1936.—In this theoretical paper spectroscopic data are used in order to calculate the equilibrium constant K_p for the gaseous reaction $2NO + O_2 = 2NO_2$ as a function of temperature. In the course of the work values are calculated for the chemical constant and the reduced thermodynamic potential of gaseous NO_2, but there is a doubt as to whether the value 2 or 4 should be taken for the statistical weight g_0 of the ground state. Uncertainty also exists as to the figure to be adopted for $\Delta E_0 = 2E_0(NO_2) - 2E_0(NO) - E_0(O_2)$, E_0 being the energy at the absolute zero. The values $\Delta E_0 = -26080$ and -25560 cal. are considered. Comparison of the calculated values for K_p with existing experimental values indicates that the best agreement is obtained for $g_0 = 4$ and $\Delta E_0 = -25560$ cal. L. A. W.

See also Abstract 373.

VAPOUR PRESSURE.

***301. Variable Vapour-Volume Barometric Type of Vapour-Pressure Apparatus. E. M. Barber and A. V. Ritchie.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 472–476, *Nov.* 15, 1936.—The apparatus consists of a special type of U-tube barometer in which one limb is open to the atmosphere, and the other is closed by a 3-way stop-cock. A levelling bottle is provided so that the level of the Hg can be

adjusted, and the closed limb is in the form of a graduated burette. The whole is contained in a thermostatically controlled water bath, fitted with a stirrer. In use the apparatus is first freed from air and vapours and a small quantity of liquid is introduced through the 3-way tap. After allowing time for temperature equilibrium to be attained, the Hg level is lowered and readings of pressure, volume of vapour and of liquid are taken. This is repeated at suitable intervals until the bottom of the burette is reached. From these data it is possible to calculate the vapour pressure over the range zero to any intermediate percentage evaporated, and this is useful in estimating evaporation losses, and in measuring the vapour-locking characteristics of petrols, etc. Sources of error are treated in full, and examples of actual experiments are given. E. H. D.

302. Vapour Pressure and Heat of Sublimation of Carbon. P. Goldfinger and W. Jeunehomme. *Faraday Soc., Trans.* **32.** *pp.* 1591–1598, *Nov.*, 1936.—Three values of the heat of vaporisation of C $L_C = 168{\cdot}8$; $123{\cdot}6$; and $107{\cdot}2$ k.cal. are discussed. These values were obtained from three values of the dissociation energy of CO, which are in agreement with the predissociation limit at 11·06 V. The vapour pressure curves of C were calculated for these values. Intermediate values can be ruled out by spectroscopic arguments. The direct measurements of the vapour pressure of C described in the literature lie mostly between the curves calculated for $L_C = 168{\cdot}8$ k.cal. and $123{\cdot}6$ k.cal.; only the values obtained from the rate of evaporation give lower vapour pressures, that is, higher heats of vaporisation. $L_C = 168{\cdot}8$ k.cal. gives the best agreement but it cannot be accepted for spectroscopic reasons. The vapour pressure calculated from $L_C = 107{\cdot}2$ k.cal. or still smaller values, is by several powers of 10 higher than can be expected from available empirical data. The most probable value of the heat of vaporisation of C is therefore $L_C = 123{\cdot}6 \pm 0{\cdot}5$ k.cal. The corresponding value for the dissociation energy of CO is $D_{CO} = 9{\cdot}10 \pm 0{\cdot}005$ V $=$ $209{\cdot}9$ k.cal. The dissociation energy of C_2 is probably of the order of $D_{C_2} \sim 4$ V ~ 90 k.cal. AUTHORS.

See also Abstract 3.

ACOUSTICS.

303. Action of Acoustic and Supersonic Vibrations on Aerosols. E. Hiedemann. *Kolloid Zeits.* 77. *pp.* 168–172, *Nov.*, 1936.—Previous work on the subject is first very fully discussed [see also Abstract 5631 (1936)], and it is shown that an aerosol in an acoustic field behaves at very low and at very high frequencies in the same way. *i.e.*, all the particles either vibrate or remain at rest; in an intermediate frequency region the particles possess differential behaviour for different amplitudes. The author next discusses the theory of acoustic coagulation and concludes with some experimental results and practical applications. H. H. Ho.

304. Diffraction of Light by Ultrasonic Waves. S. M. Rytov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 4. *pp.* 151–156, 1936. *In French.*—Mathematical. A more detailed analysis is given [see Abstract 4806 (1936)] to determine under what conditions the Raman-Nath theory holds. G. E. A.

305. Absorption of Ultrasonic Waves in Acetic Acid. P. Bažulin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 6. *pp.* 285–288, 1936. *In French.*—In acetic acid the law that the absorption varies as the square of the frequency does not hold for the range $5-10 \times 10^6\sim$. The present measurements refer to the extended range $3{\cdot}73 - 31{\cdot}3 \times 10^6\sim$. The graph of coefficient of absorption and frequency is approximately linear, but ceases to be so in the neighbourhood of the limiting frequencies. Variation of temperature has little effect on the course of the graph. A test is also made on the absorption coefficient in mixtures of benzene (α 1·03) and toluene (α 0·10). The absorptions are not additive. G. E. A.

306. Resonances of Closed and Open Rooms, Streets and Squares. G. Jäger. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 1–2. *pp.* 73–93, 1936.—The resonances of rooms, etc. are examined starting with the elementary conception of a tube closed or open at the ends. Formulæ are deduced for the resonance periods of such a tube and are used to calculate the period of the note heard, *e.g.*, when a sudden noise is made between two parallel walls. J. E. R. C.

***307. Electrical Apparatus for Making Vowel Sounds. K. W. Wagner.** *Preuss. Akad. Wiss. Berlin, Abhandlungen* 2. [44 *pp.*], 1936.—The apparatus includes a d.c. source, an impulsive oscillator to act as larynx, and five filter circuits, one for the fundamental and four for formants. Reproduction takes place by loud-speaker. The impulse oscillator circuit contains three valves capable of supplying current impulses which last 1/13th of the intervening time-intervals. The note obtained is rich in partials up to the 20th, and the fundamental has a frequency of 200 or over. For deeper fundamentals an additional circuit has to be added. Each formant can be produced independently of the others as regards frequency, damping and amplitude. It is possible with the apparatus to imitate any vowel as sounded. The basis of the method is the wave-form as obtained by microphone and oscillograph. The tone spectrum, determined by analysis of the wave-form, supplies, by the position of the resonance maxima, the formant frequencies; their height gives the strength of the formants, and their breadth the formant damping.

The formant circuits are adjusted accordingly, and the spectrum of the sound produced by the apparatus is compared with the original. The paper is richly illustrated with wave-forms of vowel sounds by different speakers and by the same speaker at different frequencies and at different times. Wave curves of constant form are obtained only from practised speakers or musically trained persons. Two appendices deal with impulse spectra and an oscillator for very short impulses. G. E. A.

308. Persistence of Sensation of Speech. M. Marro. *Phil. Mag.* 22. *pp.* 847–854, *Nov.*, 1936.—Experiments based on the analogy of persistence of vision [see Abstract 916 (1924)] are described which demonstrate that reproduction of speech is possible even when it is periodically interrupted. For clear reception of known speech, 10 interruptions per sec. are sufficient; for unknown speech, 15 are required. For clear reproduction with easy and full intelligibility, 35 to 50 per sec. are desirable. When the electric current is interrupted with the optimum frequency, the voices of women, which are richer in the higher harmonics, are perceived better than the voices of men. Articulation tests indicate that vowels are heard better than consonants. G. E. A.

309. Measurement of Phases of Acoustical Pressures. Z. Carrière. *Rev. d'Acoustique*, 5. *pp.* 1–23, *Jan.–March*, 1936.—Methods are described for detecting acoustical pressures and velocities by purely mechanical means, the object being to avoid distortions introduced by electrical circuits. Pressures are detected with a manometric capsule, and velocities by the oscillations of a small triangular flame placed, *e.g.*, at an antinode. The method is applied in determining the phase relations between displacement and pressure in a standing wave in a pipe; in analysing the vibration of air in an organ pipe (a series of capsules being used); and, by a modification of technique, to a study of the relation between the exciting force and the motion of the hammer of an electric bell. J. E. R. C.

***310. Hartmann Acoustic Generator.** *Engineering*, 142. *pp.* 491–492, *Nov.* 6, 1936.—Describes, with 24 illustrations, an air-jet acoustic generator capable of producing frequencies from about 5000 to 40,000~ with a total acoustic output of over 100 W at 10,000~ or 5 W at 40,000~. The mechanism of the sound production is analysed by means of electric spark photographs. The Riemann wave formed in front of a stationary surface on which an air jet impinges with a velocity above that of sound, or in the collison layer of the oscillator, produces such extremely rapid changes in the velocity, pressure, density and temperature of the air, that it acts like a high quality mirror for light. The crispations formed on a plane soap film by the intense sound waves were studied photographically. Tobacco smoke in a Kundt tube was precipitated almost at once in a pattern similar to that of lycopodium powder, and the precipitation in air of dust particles or ammonium-chloride smoke was studied by photomicrography. In 10 sec. the smoke content of the air was reduced to 0·03 % of its initial value of 10^4 mg./m^3. [See also 1775 (1936).] W. H. Ge.

See also Abstracts 54, 71.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***311. A.C. Bridges Using Variable Mutual Inductance. W. Geyger.** *A.T.M. No.* 64. *T*138, *Oct.*, 1936.—An account of bridge circuits in which the detector arm includes the secondary of a mutual inductance, the primary of which may be in shunt or in series with the supply, or in one arm of the bridge. In the first two cases, the frequency enters into the equations of balance (*e.g.*, the Schering-Engelhardt frequency bridge and the well-known "Hughes balance"). The third case is illustrated by bridges for the measurement of self-inductance, and of capacitance and power loss. N. F. A.

***312. A. C. Bridges with External Balancing Arrangement. W. Geyger.** *A.T.M. No.* 65. *T*150–*T*151, *Nov.*, 1936.—A previous paper [see preceding Abstract] described certain a.c. bridges in which the voltage in the detector circuit was partly balanced by including in the circuit the secondary winding of a mutual inductance, the primary of which was in series or parallel with the source of supply. The present paper extends this idea and deals with bridges in which the detector circuit includes potential tappings from a potentiometer fed, through a transformer or mutual inductance, from the bridge supply. This arrangement may be used for balancing one phase only, or a two-phase potentiometer can be arranged to balance both in-phase and quadrature components. Schemes are outlined in which the balancing is done with rectified current, and then the bridges can be made partly self-adjusting by a device in which a d.c. reflecting galvanometer is used in conjunction with a bolometer or photocell. Circuit arrangements are given for the measurement of resistance, frequency, voltage, capacity and power factor. One advantage of the schemes lies in the fact that there is a linear relationship between changes in the variable and in the external potentiometer reading. N. F. A.

CONDUCTION AND DISCHARGE IN GASES.

313. Theory of Electric Probes in Gas Discharge Tubes. B. Davydov and L. Zmanovskaja. *Techn. Phys., U.S.S.R.* 3. 8. *pp.* 715–728, 1936. *In German.*—Discussion of the probe theory of Langmuir and Mott-Smith shows that this theory is only applicable to cases where the probe radius is small compared with the free path of the electrons and ions in the gas. When this condition is not fulfilled the theory gives values considerably smaller for the electron concentration and the space potential than actually exist. A diffusion theory of probes is presented which is applicable even when the probe radius is much greater than the free path of the electrons and ions. This theory makes it possible to estimate, from probe measurements, the electron temperature and concentration and also the space potential. A. W.

314. Examination of Ionisation Processes in Gases with a Cloud Chamber. E. Flegler and H. Raether. *Zeits. f. Physik*, 103. 5–6. *pp.* 315–336, 1936.—The behaviour of free electrons and of bound electrons in establishing a continuous discharge between plane electrodes is examined

in a cloud chamber. Different behaviour is observed as the nature of the gas is changed but the mechanism for neither free nor bound electrons is appreciably affected by changes in the electrodes. F. C. C.

315. Very Short Time-Lag of Sparking. R. R. Wilson. *Phys. Rev.*, 50. *pp.* 1082–1088, *Dec.* 1, 1936.—Time-lag of sparking in the very short time interval from 5×10^{-9} sec. to 115×10^{-9} sec. has been measured as a function of overvoltage and illumination using the electro-optical shutter with a constant illumination method. It was found that down to 10^{-9} sec. the time-lags approached no lower limit if sufficiently high overvoltage was used. Variation of the intensity of illumination showed that the time-lags measured consisted of two parts, a statistical part which is the time taken for an electron to be produced in the spark gap, and a formative time of more or less definite length depending on overvoltage and during which time the actual mechanisms of spark breakdown take place. With time-lag fixed, the requisite overvoltage was found to decrease directly with the log of the intensity of illumination. To explain the formative times a simple theory of sparking at high overvoltages is advanced which assumes that the formative time-lag is the time for an electron to traverse the short distance in the spark gap necessary to produce by ionisation by collision enough ionisation to enable secondary photoelectric mechanisms of electron production in the gas and at the kathode to produce a visible spark. AUTHOR.

316. Absolute Values of the Electron Drift Velocity in Nitrogen, Helium, Neon and Argon. R. A. Nielsen. *Phys. Rev.* 50. *pp.* 950–954, *Nov.* 15, 1936.—The electrical shutter method for measuring electron mobility has been employed for measurements of the electron drift velocity in N_2, He, Ne and A. The values obtained experimentally as a function of X/p are compared with those computed by theoretical equations and a discrepancy is shown to exist. In every case the deviation of the experimental from the calculated curves is explained by the hypothesis that the distribution of electron velocities is such that occasional inelastic collisions occur. Under such circumstances the energy losses are greater than those calculated, and the experimental values of the electron drift velocity are thus greater than predicted by theory. It is shown, in all cases studied, that electrons of sufficient energy are present to produce the postulated excitations. Assuming such inelastic collisions, a value for the probability of excitation of electronic levels in He, Ne and A is calculated. The probabilities so obtained agree in order of magnitude with those given by other experiments. [See Abstract 1794 (1936).] AUTHOR.

317. Radial Distribution of Electrons in the Uniform Columns of Electrical Discharge. G. D. Yarnold and S. Holmes. *Phil. Mag.* 22. *pp.* 988–998, *Nov.*, 1936. *Supplement.*—The number of electrons per c.c. at different distances from the axis of the cylindrical discharge tube in a h.f. discharge in air was derived by measurements of the relative current received by the different parts of a tripartite anode consisting of a central disc surrounded by two concentric annuli separated by very small gaps. The results suggest that the concentration of electrons near the surface of the tube is at most a small fraction of that near the axis. In a second experiment the light emission from different parts of the tube was measured. The assumption that the light emission is proportional to the electron concentration was found to be approximately correct at low gas pressures (0·5 and 1·0 mm.), but at higher pressures the results indicate that the

electrons lose a large proportion of their energy in collisions. The second experiment was made with an electrodeless discharge in mercury vapour.
W. S. S.

318. Positive Column in Rare Gas–Hg Vapour Mixtures. K. Siebertz. *Ann. d. Physik*, 27. 5. *pp.* 421–458, *Nov.*, 1936.—Discusses the results of electrical measurements taken by means of probes in the positive columns of Ne + Hg and A + Hg gas-discharge tubes. Examples of the probe characteristics for various Hg vapour pressures are given, these results being used to obtain the relationship between electron temperature and Hg-vapour pressure. An insight into the mechanism of the positive column is thus derived, which makes it possible to explain the peculiar phenomena previously observed. **Erratum,** *ibid.* 27. 8. *p.* 741, *Dec.*, 1936.
R. C. F.

319. Field-Strengths in Positive Column of Discharges in Light and Heavy Hydrogen. M. Steenbeck. *Zeits. f. techn. Physik*, 17. 11. *pp.* 397–398, 1936. *Phys. Zeits.* 37. *pp.* 823–824, *Dec.* 1, 1936.—Measurements with Langmuir probes were made of the field-strengths and electron temperatures in the positive columns of discharges in H_2 and D_2. The results obtained are in complete agreement with the diffusion theory of the column if in the formula in question the mass is doubled. A. W.

320. Validity Limits of Diffusion Theory for Low-Pressure Hg-Vapour Positive Column. A. v. Engel. *Zeits. f. techn. Physik*, 17. 11. *pp.* 404–407, 1936. *Phys. Zeits.* 37. *pp.* 830–833, *Dec.* 1, 1936.—From measurements of electron temperature, carrier concentration and positive column field-strength, observed with a probe built into the glass wall of a Hg-vapour rectifier, the mean free path of the electrons was calculated from the current transport equation. For small currents and with auxiliary cooling the agreement between measurement and calculation from the diffusion theory is satisfactory. With greater currents differences are found which may possibly be due to pressure differences between the main discharge chamber and the branch in which the probe was situated. The measured electron temperatures, dependent on the vapour pressure, for currents between 2 and 50 A, all lie below the values calculated from the ambipolar diffusion theory. The discrepancies may be explained by step-by-step ionisation, as shown by measurements with small currents. A. W.

321. Clean-Up of Inert Gases in the Electric Discharge. Part I. H. Alterthum, A. Lompe and R. Seeliger. *Zeits. f. techn. Physik*, 17. 11. *pp.* 407–412, 1936. *Phys. Zeits.* 37. *pp.* 833–838, *Dec.* 1, 1936.—The discharge tube consists of a glass tube containing hollow Fe electrodes. It is connected to a side tube containing a Pirani gauge, but sealed off from the pump after being carefully cleaned and filled with Ne of about 7 mm. pressure. The rate of disappearance of the Ne as indicated by the gauge is found to be proportional to the current between 20 and 100 mA. It is independent of the pressure below about 2·5 mm. It is independent of the shape of the discharge tube and is apparently not connected with any kathode sputtering as it starts much earlier than the deposition on the walls. In order to find out where the Ne is adsorbed, the separate parts of the tube are heated one after the other and a large fraction of the gas is recovered from the electrodes. A separate experiment with d.c. shows that it comes from the kathode. It is suggested that the phenomenon can be explained by ions being shot into the kathode. R. P.

322. Theory of Quenching Grid Control in Gas Discharges. F. Lüdi. *Helv. Phys. Acta*, 9. 8. *pp.* 655–677, 1936. *In German.*—A

theory is developed for the quenching process in a Hg vapour d.c. arc discharge, which can be interrupted without loss by specially-constructed, negatively-charged quenching grids. The quantitative treatment is an expansion of Schottky's theory of a positive column in the non-stationary case, and takes into account the valve radius for short-path lengths as well as the special case of long-path lengths discussed in the Tonks-Langmuir theory. The quenching time is calculated and the order of magnitude of 10^{-4} sec. is confirmed by experimental measurement. The relationship between vapour density and grid aperture diameter is also discussed and compared with experimental observations. [See also Abstract 3133 (1935).] E. T. A. R.

323. Argon Low-Voltage Arc Characteristic. H. Kniepkamp. *Zeits. f. techn. Physik*, 17. 11. *pp.* 398–404, 1936. *Phys. Zeits.* 37. *pp.* 824–830, *Dec.* 1. 1936.—The l.v. arc in A is investigated for hot kathodes, particularly oxide kathodes, in respect of the form of the current-potential characteristic. The characteristic of the non-oscillating l.v. arc in A, has one part, below the lowest excitation potential of A, exhibiting to a slight extent dependence of the arc potential on the current, followed by a steep part, in the region of smaller currents, to a little above the ionisation potential. With further decrease of the current the arc potential rises into the region of the oscillating arc. The characteristic of the non-oscillating arc is practically independent of the magnitude of the gas pressure in the discharge tube and of the distance between anode and kathode in the region of technical interest. A variation of kathode temperature effects a definite displacement of the characteristic. The oscillations in the oscillating arc consist of time fluctuations of the space charge structure. The potential oscillations are limited in amplitude by the ionisation potential and the l.v. arc potential. The frequency is dependent in a characteristic manner on the mean direct current though the discharge tube. A. W.

324. Anomalous Effects in Ionic Collisions with Resonance Excitation. F. Wolf. *Ann. d. Physik*, 27. 6. *pp.* 543–572, *Nov.*, 1936.—Certain discrepancies between the results of earlier measurements on the relation between discharge diameter and ionic velocity and those predicted theoretically are cleared up by some improvements in the apparatus and method of measurement. Additional information is also given concerning discharge effects occurring in ionic processes in H_2, N_2, He, Ne and A in the range 30 to 1020 V. A number of different collision processes are observed and experimental curves show minor irregularities; a type of Ramsauer effect is also noticed. Discharge-velocity curves for 11 types of collision are given; for those with negative resonance excitation a more or less sharply defined maximum (or maxima) is observed (theoretically a steady fall with velocity should be observed); for those with positive excitation a pronounced maximum is obtained. The reasons for these departures from theory are discussed. The resonance principle of Kallmann and Rosen is found, in general, to be valid, although important exceptions occur, for which an explanation is offered. H. J. H. S.

325. Determination of Ionic Densities by the Gas Current Method, Allowing for Defective Insulation. P. Mercier and G. Joyet. *Helv. Phys. Acta*, 9. 8. *pp.* 642–646, 1936. *In French.*—In measuring the density of the charges carried by a current of ionised air, a cylindrical condenser is used with its axis parallel to the direction of the current and a radial electric field serves to collect on the central electrode all the charges of one sign which enter the condenser. An electrometer

connected to the central electrode serves to measure the rate of increase of charge. Such measurements are liable to error owing to leakage across the electrometer insulation and across that of the central collecting electrode. Formulæ are derived for calculating the ionic densities when due allowance is made for leakage. A. W.

***326. Use of a Thermo-Probe for Investigation of Gas Plasma. M. Gorschkow and J. Maslakowez.** *Techn. Phys., U.S.S.R.* 3. 9. *pp.* 824–831, 1936. *In German.*—A new method is described for investigating the characteristics of gas plasma, use being made of a thermo-probe consisting of a Cu-constantan thermocouple. The method has given promising results, as it enables determinations of the space potential, electron temperature and other allied quantities to be made in an entirely new way. With further development of the method it should be possible to determine the gas temperature at a given point of a discharge. By use of the thermo-probe it is possible to follow the processes of electron temperature adjustment, as well as the growth of the anode fall of potential. Preliminary results only are given in the present paper. A fuller investigation of the method and of the relation between the temperature difference of the probe and the energy difference will be given in a subsequent paper. A. W.

***327. Heavy-Current Discharge Tube. A. Hunter and R. W. B. Pearse.** *Journ. Sci. Instruments,* 13. *pp.* 403–407, *Dec.,* 1936.—A water-cooled cold-kathode discharge tube of simple construction and assembly is described. It runs on high-voltage (over 1500 V.) d.c. or a.c., and can dissipate 3 kW. for short runs, or half that power indefinitely. It is suitable for use with many different gases, and particularly with hydrogen as a source of an ultra-violet continuum. The tube may be employed in emission and absorption spectroscopy, photochemistry, spectrophotometry, and photographic sensitometry. The chief advantages are simplicity, robustness, portability, and constancy of intensity. Spectrograms are reproduced to facilitate the identification of impurities commonly occurring in spectroscopic work. AUTHORS.

***328. Direct-Reading Counting Rate Meter for Random Pulses. N. S. Gingrich, Robley D. Evans and H. E. Edgerton.** *Rev. Sci. Instruments,* 7. *pp.* 450–456, *Dec.,* 1936.—Randomly distributed pulses, of any voltage shape, and of varying magnitude, actuate an amplifier whose output meter indicates only the average rate of arrival of the pulses. Counting rates of 30 per min. up to several thousand per min. are read directly from a rugged meter. The apparatus is a.c. operated, is portable, and is particularly adapted to the study of feeble γ-radiation. The apparatus consists essentially of a pre-amplifier, a uniform pulse generator based on a relaxation oscillator or on an inverter circuit, an output amplifier stage, and a capacity-resistance electrical tank circuit for performing the averaging process. AUTHORS.

***329. Statistical Analysis of Counting Rate Meter. L. I. Schiff and Robley D. Evans.** *Rev. Sci. Instruments,* 7. *pp.* 456–462, *Dec.,* 1936. —The counting rate meter, or vacuum tube speedometer, is an integrating and averaging instrument with an electrical, exponentially decaying memory. It is designed to replace message-register equipment in all particle counting apparatus, and is ideally suited to continuous photographic recording. The average current to the output meter is proportional to the counting rate for constant sources or for decaying sources whose mean life is significantly greater than the time constant RC of the

output tank circuit. This RC is analogous to a radioactive mean life and may be regarded as the mean memory time. While the output current depends only on the output resistance R, and not on the output capacitance C (except for very rapidly decaying sources), the statistical fluctuations in the output current depend upon RC, and are equivalent to the fluctuation expected in a time interval of 2RC. Expressions are derived for the condenser charge Q, or output current Q/RC, for constant and decaying sources of radiation, as well as for the expected *fractional* statistical fluctuations in these cases. AUTHORS.

***330. Geiger-Müller Counters. J. C. Mouzon.** *Rev. Sci. Instruments*, 7. *pp.* 467–470, *Dec.*, 1936.—A simple amplifier and recorder circuit for discriminating between partial and total coincidences of Geiger-Müller counters is described. AUTHOR.

***331. Portable Wilson Cloud Machines. G. L. Locher.** *Rev. Sci. Instruments*, 7. *pp.* 471–478, *Dec.*, 1936.—Two new forms of Wilson cloud apparatus, developed for stratosphere balloon flights and suitable for portable use, are described. The machines are of light weight, require only small amounts of electric power and are arranged for optional control by Geiger-Müller counters. Both machines employ baffles for removing turbulence from the cloud chamber; one uses a metal bellows, but no diaphragm; the other uses a thin rubber diaphragm and a bellows pump. Vacuum tube circuits control the timing of events connected with the expansion cycle. Stereophotographs are taken with flash bulbs, or with a spark illuminator that uses only 10 W from an a.c. supply. AUTHOR.

***332. Thyratron-Controlled Ionisation Gauge. J. B. Hoag and N. M. Smith, Jr.** *Rev. Sci. Instruments*, 7. *pp.* 497–499, *Dec.*, 1936.—A thyratron is used to maintain constant the ionising electron current in an ionisation gauge. A circuit operating entirely from the alternating current supply line is given, together with the constants found suitable in the particular apparatus used and including provision for outgassing the metal parts of the gauge. The thyratron control was found to maintain constant electron current over the usual pressure range and with line voltage fluctuations of $\pm$ 6 %. AUTHORS.

See also Abstracts 7, 13, 14, 224, 260, 367.

CONDUCTION IN SOLIDS AND LIQUIDS.

***333. Use of Current Balance. F. W. Warburton.** *Am. Phys. Teacher*, 4. *pp.* 125–127, *Sept.*, 1936.—In order to use a few physical quantities in the defining of electric current and yet remain in agreement with the various modes of measurement, omission of μ_0 and introduction of c by dimensional analysis, in the equation of total electric and magnetic force on a moving charge, is favoured. Absolute determination of the ampere by a current balance gives a partial definition of current as that quantity which exerts magnetic force on a like current. In the student form of current balance described, the attraction and repulsion of current in long straight parallel wires is measured on a beam balance; the computation is particularly simple. Ammeters may be calibrated to within 1 %. AUTHOR.

***334. Ballistic Galvanometer as Null Instrument. G. Dupouy.** *Comptes Rendus*, 203. *pp.* 987–989, *Nov.* 16, 1936.—The errors arising in the use of a ballistic galvanometer as a null instrument, when the opposing impulses are not applied at precisely the same moment, may be rendered negligible by taking two readings with the balance slightly disturbed,

first in one direction and then in the other, and interpolating to obtain the true balance reading. Using this method a ballistic galvanometer may conveniently be substituted for a fluxmeter as a null instrument in magnetic measurements, giving increased sensitivity and obviating the limitation of the instrument circuit resistance to a low value. C. E. W.

***335. Supraconducting Galvanometer. H. G. Smith, K. C. Mann and J. O. Wilhelm.** *Roy. Soc Canada, Trans.* 30. *Sect III. pp.* 13–30, *May*, 1936.—The construction and operation of a supraconducting galvanometer which enables one to measure directly any persistent currents that may be applied to its coils or that actually flow through them is described. The agreement between predicted behaviour and experimental results is quite satisfactory. The addition of a supraconducting switch proves definitely that circulating currents flow through the galvanometer circuit, and provide a convenient means of controlling stray currents that might be " locked in " accidentally. It will henceforth be an integral part of the galvanometer. The use of the galvanometer to measure the maximum persistent current in tin seems to indicate that its success as an instrument to measure the growth and decay of persistent currents in supraconductors is assured. [See also Abstract 814 (1936).] AUTHORS.

336. Explanation of the ' Branching ' Temperature in Disc-Shaped Hot Conductors. E. Spenke. *Arch. f. Elektrot.* 30. *pp.* 728–736, *Nov.* 21, 1936.—In an earlier paper [see Abstract 294 (1936)] substances having a negative temperature coefficient of resistance, which, therefore, become better conductors at high temperatures, have been called hot conductors. Plates of such materials possess a critical temperature, the ' branching ' temperature, above which they are no longer uniformly heated by the passage of an electric current. This may lead to the destruction of the plate. A simple method is given to show how this occurs and for calculating the ' branching ' temperature. For this purpose the plate is considered to be replaced by two parallel circuits each containing a hot conductor, the two being thermally connected. The ' branching ' arises from the fact that when the critical temperature is exceeded there are two temperatures of each hot conductor for which a given potential difference produces the same current. R. W. P.

337. Application of Thermodynamics to Supraconduction. A. J. Rutgers. *Physica*, 3. *pp.* 999–1005, *Nov.*, 1936. *In German.*—At the basis of recent work on the application of thermodynamics to supraconduction lie the following hypotheses: (1) The normal supraconducting transition is to be treated as a reversible phase transition; (2) for the supraconducting phase there exists a magnetic condition equation which, for the case of a long ellipsoidal body, is $B = H + 4\pi d\sigma_s = 0$; (3) at the normal jump point the heat toning disappears at the phase transition. J. J. S.

338. Electrical Resistance and Reflecting Power of Metallic Films Condensed at Low-Temperatures. R. Suhrmann and G. Barth. *Zeits. f. Physik*, 103. 3–4. *pp.* 133–169, 1936.—Opaque, or nearly opaque, mirrors of Al, Ag, Cd, Tl, Pb and Bi are formed by condensation at temperatures between 20° and 80° K., and are then gradually warmed to room-temperature. Non-reversible changes in electrical resistance and in the spectral reflectance (measured between 6000 and 2500 Å) accompany the warming. These changes are related to a progressive change in the arrangement of the atoms, from a random to an ordered condition. In the random condition the resistance contains a component of high value,

nearly independent of the temperature, which gradually falls, on cooling to room-temperature, to a value which is lowest for the metals having the lowest characteristic temperature. After the warming of the mirror, the spectral reflectance agrees with that calculated from the optical constants obtained from crystalline mirrors. D. H. F.

339. Dependence of Ionic Conductivity of Solids on Pressure. W. Jost and G. Nehlep. *Zeits. f. phys. Chem.* 34. *Abt.B.* 5. *pp.* 348–356, 1936.—The abnormally high value obtained for the constant A in the formula for the conductivity : = Aexp. (− Q/RT) is explained by the assumption that pressure influences the conductivity of ionic crystals. Measurements are made with AgCl and AgBr and the assumption is confirmed within the limits of the accuracy of the determinations. F. J. B.

340. Grotthus Conductivity of Fused Electrolytes. T. Erdey-Grúz. *Zeits. f. phys. Chem.* 178. *Abt.A.* 2. *pp.* 138–142, 1936.—It is found that the equivalent conductivity of fused electrolytes, measured near their melting points, in most cases is much higher than the values calculated from the Walden law in which complete dissociation into simple ions is assumed. This " over-dissociation " is considered to indicate the presence of Grotthus conductivity. F. J. B.

See also Abstracts 25, 50, 145, 280, 342, 349.

DIELECTRICS AND CAPACITANCE.

341. Dielectric Behaviour of Caoutchouc. F. H. Müller. *Kolloid Zeits.* 77. *pp.* 260–267 ; *Disc.*, 267, *Nov.*, 1936.—An explanation based on the Debye dipole theory is given for dielectric loss and dielectric constant variation for caoutchouc vulcanisation agents with varying amounts of S. The dipoles are due to the S bridges, and it is shown that, on analogy with the mechanism of liquid friction, there is an appreciable mobility of the dipoles coupled with the isoprene chains. To this phenomena is ascribed essentially the temperature and frequency dependence of dielectric constant and loss in caoutchouc. Possibilities for the application of this dipole theory to similar cases of amorphous solid bodies are discussed. A comparison with the results of Curtis, MacPherson and Scott is included. H. H. Ho.

342. Dielectric Constant, Conductivity and Piezo-Effect of Rochelle Salt Crystals. H. Körner. *Zeits. f. Physik*, 103. 3–4. *pp.* 170–190, 1936.—The dielectric constant was measured as a function of field-strength and temperature, and corresponding results were obtained both by a ballistic and by a static method. Residual changes are explained in terms of hysteresis, and an apparent pyro-effect was shown to be a consequence of the piezo-effect. Investigation of the piezo-effect in each of the 18 possible modes of vibration shows that only 3 are present, in accordance with the Neumann-Voigt theory. D. H. F.

343. Dielectric Constants of Gases and Vapours. M. Kubo. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 657. *pp.* 169–179, *Nov.*, 1936. *In English.*—The dielectric constants of the vapours of methylene glycol diethyl ether, ethylidene diethyl ether, and diethyl carbonate, the molecules of which contain two active axes of free rotation, are measured and used to calculate the dipole moments for various temperatures. The moment of methylene glycol diethyl ether increases with rising temperature. Intramolecular rotations are hindered ; the molecule executes rotatory oscillations about the position of minimum potential

energy, in which two ethyl groups are not located on the O-C-O plain. The same is true for ethylidene diethyl ether. The moment of methylene glycol diethyl ether is higher than that of methylene glycol dimethyl ether, and ethylidene diethyl ether has lower moment than the former. This is explained in terms of intramolecular forces. The moment of diethyl carbonate is independent of temperature. [See Abstract 4336 (1936).]

AUTHOR.

***344. Precision Arrangement for the Determination of the Molecular Polarisation of Non-Dissociating Liquids. G. Rösseler.** *Zeits. f. Physik*, 103. 3–4. *pp.* 191–216, 1936.—The object of the research described in this paper is the development of a better arrangement of greater precision and possessing both accuracy and capability of easy reproduction. A double oscillation method was used and is fully described. The arrangement developed, instead of the self-excited sender hitherto used, employs as sender a quartz oscillator which is kept at constant temperature. The frequency changes of the transmitter are kept down to a minimum through use of the electron-coupled sender connection and highest stabilisation of the working voltage. A water thermostat maintains the high constancy of temperature of the liquid condenser of 0·002° C. The structure of the oscillation circuit and the choice of the region of measurement of the normal condenser ensure the reproducibility of all measured values. The method is employed to determine the molecular polarisation and the dipole moment of acetone and di-ethyl ketone in benzene. A considerable increase is shown in comparison with all previous measurements. J. J. S.

345. Behaviour of Anisotropic Liquid in D.C. and A.C. Electric Fields. V. Freedericksz and G. Michailow. *Acta Physicochimica*, 5. 3. *pp.* 451–463, 1936. *In German.*—The absence of the dielectric loss maxima in the frequency region from 10^5 to $10^6 \sim$ both in the isotropic (131° C. to −145° C.) and in the anisotropic condition was established. The falling-off in the conductivity with increase of the electric field is presumably characteristic of liquids brought into mechanical motion. The study of conductivity and dielectric loss in the way described yields no distinction between anisotropic and isotropic phases of the liquid. J. J. S.

346. Anomalous Dispersion in Dipole Liquids. J. Malsch. *Zeits. f. techn. Physik*, 17. 11. *pp.* 423–425, 1936. *Phys. Zeits.* 37. *pp.* 849–851, *Dec.* 1, 1936.—In order to explain the results of recent absorption measurements made on glycerine, it is necessary to assume the existence of relaxation time for the dipole structure as well as the true relaxation time of the dipole. Tests with electrolytic solutions in glycerine indicate the presence of separate oscillations of ionic complexes in the region of short electric waves. A. M. T.

347. Electric Saturation and Critical Point of Dissolution. A. Piekara and B. Piekara. *Comptes Rendus*, 203. *pp.* 1058–1060, *Nov.* 23, 1936.—Recent work on electric saturation in mixtures of nitrobenzene and benzene [see Abstract 5671 (1936)] indicates that the electric field works in two ways on the dielectric constants of liquids having permanent dipoles, viz. a negative effect due to the orientation of the dipoles in the external field, and a positive effect of different origin. In the present paper the change of dielectric constant has been measured under the action of an electric field for a mixture of nitrobenzene and hexane having a critical point of dissolution, in order to establish the existence of the positive effect under different conditions. The effect has

also been examined for a critical concentration as a function of temperature. The results prove the existence of the positive effect, which is found to be proportional to the square of the intensity of the electric field, except for small concentrations and for pure nitrobenzene. H. H. Ho.

348. Electrostriction of Highly Condensed Gases. J. Jaumann and E. Kinder. *Zeits. f. Physik*, 103, 3–4. *pp.* 263–275, 1936.—The dependence on pressure of the electrostriction of H_2, A, CO_2, N_2 and CO was investigated by the a.c. field with the arrangement of Jaumann and Stipa, which was improved in details [see Abstract 5209 (1934)]. The experiments were carried out in the pressure region 1 to 50 atm. abs., and in the temperature region $-8°$ C. to $+ 36°$ C. Previously determination of the electrostriction of gases in a l.f. a.c field with the compensation microphone brought contrary to the hitherto statistic method a considerable raising of the accuracy of the measurement through the full abolition of the influence of temperature [see Abstract 3185 (1933)]. The deviation of the electrostriction from the value thermodynomically deduced from the Clausius-Mossotti equation has been re-determined in the case of CO_2 and N_2 and is independent of temperature. It can be shown by the formation of a very small and otherwise unobservable number of double molecules under the action of the electric field in full agreement with experiment. J. J. S.

349. Voltage Dissociation Effect in Liquid Dielectrics. K. H. Reiss. *Zeits. f. phys. Chem.* 178. *Abt.A.* 1. *pp.* 37–42, 1936.—The large increase in the conductivity of liquids such as hexane, ether, etc. at high field strengths is attributed to voltage dissociation. The relation between conductivity σ and field strength E is approximately $\sigma = Ae^{b\sqrt{E}}$, where A and b are constants. E. R.

350. Structural Dielectric Losses in Plastified Glucose. B. Alexandrow, P. Kobeko and E. Kuvshinski. *Techn. Phys., U.S.S.R.* 3. 9. *pp.* 769–777, 1936. *In English.*—A study has been made of the temperature-frequency relations of the dielectric constant ϵ and the tangent of the angle of loss tg δ_{max}, in solutions of sugar and glycerin, at frequencies of 50 and $1{\cdot}7 \times 10^6\sim$. The introduction of glycerin into the glucose causes a displacement with temperature of tg δ_{max} for structural losses towards a higher temperature, and of tg δ_{max} for Debye losses towards a lower temperature. An explanation of the time of relaxation is given, and calculations of it, based on the supposition of the existence in the glucose molecules of several positions of equilibrium for different energy barriers are carried out. [See Abstract 4342 (1936)]. AUTHORS.

351. Theory of Absorption and Dispersion in Paramagnetic and Dielectric Media. C. J. Gorter and R. de L. Kronig. *Physica*, 3. *pp.* 1009–1020, *Nov.*, 1936. *In English.*—The energy losses arising in a dielectric or magnetisable medium under the influence of an applied periodic field are treated on the basis of very general assumptions regarding the constitution of the medium. The results on the absorption in paramagnetic alums are discussed on the basis of the theory. G. E. A.

***352. Capacitance Attenuator. N. F. Astbury and T. I. Jones.** *Journ. Sci. Instruments*, 13. *pp.* 407–411, *Dec.*, 1936.—A capacitance attenuator covering a range from 40 to 100 db is described in which there are no errors due to conductance effects, and in which the effects due to inductance at high frequencies are very small. An account is given of an application of the instrument to the measurement of capacitances as

small as 0·001 $\mu\mu$F to within 0·0001 $\mu\mu$F. For larger capacitances the limiting accuracy claimed is 1 %. AUTHORS.

See also Abstracts 167, 270, 371.

ELECTROCHEMISTRY.

353. Cells of Two Liquids on Gelatin. Suzanne Veil. *Comptes Rendus*, 203, *pp.* 1060–1061, *Nov.* 23, 1936.—The e.m.f. of the cell Pt soln.I gelatin soln. II Pt is the algebraic sum of the electrometric potentials of the cells Pt H_2O gelatin soln. I Pt and Pt H_2O gelatin soln. II Pt, which in some cases is considerable. Thus with solutions of $Fe(NO_3)_3$ and Na_2S as solutions I and II it is approximately 1·45 V. E.m.f. is similarly obtained if solutions I and II are both of the same salt, but of different concentrations. In this case with an acid electrolyte the positive pole is in the solution of higher concentration, with a basic solution the reverse. [See Abstract 3329 (1936).] C. A. S.

354. Meaning of Diffusion Potential. E. A. Guggenheim. *Phil. Mag.* 22. *pp.* 983–987, *Nov.*, 1936. *Supplement.*—The different senses in which the term "diffusion potential" is employed by various experimenters are explained and clarified. W. S. S.

355. Electrochemical Covering of Metallic Surfaces. O. Erbacher. *Zeits. f. phys. Chem.* 178. *Abt.A.* 1. *pp.* 15–28, 1936.—The electrochemical deposition of a monatomic layer of atoms of a noble metal on the surface of a less noble metal is considered to lead to a number of conclusions based upon experimental results. No exchange takes place between the nobler ion and the less noble metallic ion, but only a slight adsorption, if the less noble metal is not attacked by the solvent in the presence of the nobler ions. An exchange of nobler ion and less noble ion takes place from place to place, and leads to a monatomic layer of the nobler atoms. Deposition also occurs as the result of local elements, the less noble metal acting as the dissolving electrode. F. J. B.

356. Influence of Preliminary Treatment of Electrochemical Deposition. O. Erbacher. *Zeits. f. phys. Chem.* 178. *Abt.A.* 1. *pp.* 43–56, 1936.—The effects of preliminary treatment of surfaces of Pt, Pb, Bi and Ni upon the electrochemical deposition is investigated. The preliminary treatment was polishing with fine emery paper, and by rolling in the case of Pt, scraping and cleaning in 20 % HNO_3 for Pb, polishing with fine emery and etching with 20 % HNO_3 for Bi, polishing with emery, fine polishing with chalk followed by etching with HNO_3 in the case of Ni. Mechanical treatment led to the formation of active local elements bringing about solution. Etching caused these local elements to become inactive. By polishing and particularly by etching nickel became partially passive and formed active solution local elements which caused the deposition of considerable amounts of Bi. F. J. B.

357. Electrolytic Preparation of Heavy Water. V. T. Chiplonkar. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 463–467, *Oct.*, 1936.—A quantitative estimate is given on the basis of Urey's equation, of the decrease in efficiency in the electrolytic separation of D_2O (assumed to be present in small proportions) due to the continual addition of fresh-water in terms of the variables involved. It is shown that compared with a single stage process, there will be no loss in efficiency, if fresh-water be added continuously. A relation connecting the decrease in efficiency with the relative magnitude of the step is derived. AUTHOR.

358. Electrolytic Formation of Persulphate. Part II. R. Matsuda and T. Nishimori. *Chem. Soc., Japan, Bull.* 11. *pp.* 650–659, *Oct.*, 1936.—It was proposed in the previous report [see Abstract 1826 (1936)] that $H_2S_2O_8$ is produced when H_2SO_4 is oxidised by the OH-ions discharged at the anode. The present paper confirms this view and brings the mechanism of electrolytic formation of persulphate into line with that previously proposed for Kolbe's reaction, thereby showing that electrolytic oxidation of both inorganic and organic compounds is explicable by one and the same theory. The electrolytes were performed without diaphragm, in contrast with those in Part I in which a porcelain cylinder was employed as such, and the favourable effect of using an ignited Pt-anode was clearly observed in the case of solutions containing $(NH_4)_2SO_4$. H. H. Ho.

359. Preparation of Nitric Esters by Electrolysis. V. Öhman. *Zeits. f. Elektrochem.* 42. *pp.* 862–872, *Dec.*, 1936.—When anodes with high O_2 over-voltage are used, electrolysis of HNO_3 in the presence of an unsaturated organic compound such as C_2H_4 results in the formation of esters at the anode. The mechanism is considered to involve direct addition of NO_3 groups. A series of experiments is carried out with C_2H_4 in order to investigate various factors such as concentration of unsaturated compound, water content of the anodic liquid, current density and electrode material. The applicability of the method is then demonstrated by experiments with a number of different unsaturated compounds using Pt anodes. Nitric esters are easily produced, not only from unsaturated hydrocarbons but also from unsaturated derivatives such as alcohols, acids, etc. All the products have the character of explosives and the method may be of importance in their preparation. L. A. W.

360. Transference Numbers of Colloidal "Ferric Hydroxide." J. W. McBain and Winifred McC. Thomas. *J. Phys. Chem.*, 40. *pp.* 997–1004, *Nov.*, 1936.—The transference numbers of Fe and Cl in a "ferric hydroxide" sol are measured by the Hittorf and moving-boundary methods, which are found to give identical results within the limits of experimental error. The importance of making such measurements in accordance with methods established for use with simple electrolytes is pointed out. The interesting and significant physicochemical properties of "sol 13," as reported in this and two previous communications, are summarised. AUTHORS.

361. Electrometric Potential and Constitution of Electrolytes. Suzanne Veil. *Comptes Rendus*, 203. *pp.* 928–930, *Nov.* 9, 1936.—The electrometric potentials [see Abstract 3329 (1936)] of saturated solutions of the nitrates of 24 elements are determined, and plotted against the atomic weights of the elements. The result is a periodic curve with maxima for Be, Al, Cr, Fe, Zn, Ag and Hg and minima for the five alkalis and (less marked) Mn and Ni. C. A. S.

362. Changes in Kathodic Overvoltage on Platinum over Long Periods. G. Masing and G. Laue. *Zeits. f. phys. Chem.* 178. *Abt. A.* 1. *pp.* 1–14, 1936.—The increase of H-overvoltage on Pt over periods up to 20 hr. is investigated for alkaline electrolytes. For heavy constant current densities the value rises at first rapidly and then more slowly to a constant b given by $dE/d\log I = b = 0{\cdot}109$. For potentials maintained at constant values $b = 0{\cdot}120$, in agreement with Volmer's theoretical value of $0{\cdot}116$. Previous kathodic and anodic treatments of the Pt cause more rapid and slower attainment of the same end value, respectively. On a recrystallised surface the end value is lower than on polished Pt and takes longer to

attain. The results are taken to confirm the double layer theory of polarisation, but a linear relation between overvoltage and quantity of H_2 generated, appears inexplicable. D. R. H.

363. Anode Potential of Chromium with Asymmetric A.C. Electrolysis. A. Geldbach and M. Schlötter. *Zeits. f. Elektrochem.* 42. *pp.* 889–900, *Dec.*, 1936.—Few of the recent researches employing asymmetric a.c. electrolysis (d.c. component and a.c. component together) have concerned themselves with the anodic decomposition of passive metals, particularly Cr. The present paper describes experimental researches into the superposing (at different frequencies) of a.c. on thermit Cr cylindrical cast anodes in N H_2SO_4 and N HCl. The results are fully exhibited in graphs. J. E. B.

364. Relaxation Effect in Solution of Strong Electrolytes. E. N. Guryanova. *J. Chem. Phys.* 4. *pp.* 741–743, *Nov.*, 1936.—Mathematical. F. J. B.

365. Theory of Electrokinetic Effects in Solution—Reactions between Ions and Polar Molecules. E. A. Moelwyn-Hughes. *Roy. Soc., Proc.* 157*A*. *pp.* 667–679, *Dec.* 2, 1936.—According to the author's theory of the kinetics of chemical reactions between ions and polar molecules the term P in the expression $k=PZe^{-E_A/RT}$ has the order of magnitude unity. In the present paper the earlier work is refined by introducing an approximate expression for the average electrostatic energy of interaction between the ion and the reacting dipole. It is thus made clear how far, and under what conditions, P can deviate from unity. Theoretical predictions of the influence of electrolytes on k, of the temperature on E_A, and of the charge on the ion and the sign of the dipole on P are consistent with known facts. The treatment incorporates the rule of Nathan and Watson (*J. Chem. Soc. p.* 890, 1933), and suggests the desirability of allowing for the ion-dipole interaction in the theory of so-called interionic phenomena in solution. The limitations of the theory are admitted and outlined. [See also Abstract 3335 (1936).] Author.

See also Abstracts 253, 372.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

***366. Electronic Analysis of Surfaces. R. J. Moon and W. D. Harkins.** *J. Phys. Chem.* 40. *pp.* 941–957, *Nov.*, 1936.—The construction of an electron diffraction camera for use with slow ($<$ 1000 V) electrons is fully described. The angle of incidence was kept fixed and equal to the angle of reflection, and the diffraction maxima observed in the collector current-accelerating voltage curve as the voltage was varied. A spacing of 3·2 Å normal to the surface plane was observed with liquid oleic acid, and another of 45 Å when the angle of incidence was low. Weakening of the diffraction maxima was observed on prolonged exposure of the oleic acid to the electron beam, and this is attributed to decomposition of the acid by the electrons. Inner voltages of 0 and 10 V were observed with freshly cleaved (100) rock-salt faces. The (100) cleavage plane of galena gave no well-defined maxima at room-temperature, but at 206° C. maxima corresponding to an inner voltage of 16·9 V were observed. Half-order diffractions were observed. The importance of carrying out the diffraction of slow speed electrons in absolutely grease-free apparatus is emphasised, and it is shown that bombardment of a galena surface with slow electrons

at 206° C. in the presence of a trace of organic vapour permanently destroys the grating properties of the surface layer. A. G. Q.

***367. Electron-Optical Methods in Mass Spectrography. L. Cartan.** *Comptes Rendus*, 203. *pp.* 867–869, *Nov.* 3, 1936.—An axially symmetrical electrostatic electron lens is applied to the focusing of positive ions in a mass spectrograph. The lens comprises three parallel apertured disc electrodes arranged perpendicular to the beam axis the central disc being fitted with a grid across its aperture and biassed negatively with respect to the two outer discs which are maintained at the same potential. A negative bias of 4000 V on the centre disc gives a lens of 10·8 cm. focal length with which 40,000-V ions are focused on a photographic plate. From experiments in which the centre grid is replaced by plates drilled with numerous holes it is established that the intensity of the image is linearly proportional to the number of holes and by using 80 holes of 0·1 mm. dia. the exposure time of a Schumann plate is reduced from a few minutes to a few seconds. J. E. K.

***368. Application to Photography of a Method for Amplifying the Energy of Photons. A. Lallemand and E. Esclangon.** *Comptes Rendus*, 203. *pp.* 990–991, *Nov.* 16, 1936.—The electrons emitted from a photo-kathode on which an optical image is projected are accelerated and made to yield by the methods of electron optics an electron image on a photographic plate, which is a faithful reproduction of the optical image. The method provides a highly sensitive photon counter. Its application to determinations of stellar magnitude is proposed; a gain in sensitivity over visual observation of about ten magnitudes is anticipated. W. S. S.

***369. Apparatus for Transformation of Light of Long Wave-Length into Light of Short Wave-Length. F. Coeterier and M. C. Teves.** *Physica*, 3. *pp.* 968–976, *Nov.*, 1936. *In English.*—The light transformer which originally comprised plane parallel transparent photo-kathode and fluorescent screen, with a perpendicular homogeneous electrostatic accelerating field between, is improved by application of an electron-optical focusing field due to a long magnetic coil. This improves the sharpness of the image on the fluorescent screen by a factor of about 100. The practical limit of resolving power is given by the size of grain and thickness of the fluorescent screen. In order to avoid rotation of the picture as obtained with the long magnetic coil a steel ring magnet is applied having a field equivalent to two similar short coils through which current flows in opposite directions. The transparent photo-kathode comprises a base layer of evaporated Pt covered with a thin film of quartz activated with Cs on Ag_2O in the normal manner. J. E. K.

See also Abstracts 33, 34, 267, 324.

ELECTROSTATICS.

370. Conducting Insulated Spheres in a Homogeneous Electric Field. W. Krasny-Ergen. *Ann. d. Physik*, 27. 5. *pp.* 459–471, *Nov.*, 1936.—The field distribution when 2 insulated conducting spheres are brought into a homogeneous electric field is calculated with the object of explaining the formation of *Perlschnüren* from colloid particles in an electric field. The field energy determined by the presence of the spheres is given in the form of a series. Calculation shows that the spheres have a tendency to take up such a position that their common axes lie parallel to the field; this explains the formation of *Perlschnüren*. This result may be deduced

by considering the dipoles induced on each sphere by the field. It is shown quantitatively that the work done against the repulsive forces in bringing one sphere up to the other from infinity when their common axes are normal to the field is less than that done by the attractive forces when their common axes lie parallel to the field. As a numerical example it is shown that the energy of the Brownian movement which tends to destroy the *Perlschnüren* is very much less than the electrical energy which leads to their formation. H. J. H. S.

371. Permanent Polarisation of the Electret. G. Groetzinger and H. Kretsch. *Zeits. f. Physik*, 103. 5–6. *pp.* 337–349, 1936.—The permanent polarisation which is set up in beeswax if it is cooled in an electric field, is destroyed upon melting. This can be shown by connecting an electrometer to two electrodes touching opposite surfaces of the " electret." Upon melting, the electrometer registers a certain amount of charge. If instead of heating the wax to its melting point it is kept at intermediate temperature, a smaller charge is found. If, however, instead of solidifying in an external field, the wax is only cooled in a field from a temperature T below the melting point, the polarisation can be completely destroyed by heating it again to the temperature T. Applying a h.f. field not only heats the substance but also, in addition, accelerates the depolarisation. It cannot, however, set free more charge than would be set free, at the same temperature, without the h.f. field. R. P.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

372. Analysis of the Magneto-Galvanic Effect. V. Sihvonen and P. Veijola. *Zeits. f. Elektrochem.* 42. *pp.* 833–837, *Nov.*, 1936.—The effect of a magnetic field on the potential of an Fe electrode immersed in a solution of $FeCl_3$ observed by Gross, and by Sihvonen and Kerkkränen in an ammoniacal $CuCl_2$ solution at a Cu electrode with an Fe core is explained, in agreement with experiment, by the theory that the kations formed in the free processes : $2\,Fe^{+++} + Fe \rightleftarrows 3\,Fe^{++}$ and $Cu^{++} + Cu \rightleftarrows 2\,Cu^{+}$ exhibit a weaker paramagnetism than the reacting kations. The latter under the action of the magnetic field are first attracted through the zone of reaction to the metal, and second, accelerate the speed of reaction at that place. Both actions set up changes of potential which may be positive or negative according to the nature of the change in the composition of the electrolyte, and to the mutual electrochemical behaviour of the two kinds of ions of the same metal at the phase boundary. G. E. A.

373. Effect of Magnetic Field on Transformation Temperatures. E. Justi. *Phys. Zeits.* 37. *pp.* 766–768, *Nov.* 1, 1936.—If the phases of a unitary system possess different susceptibility its equilibrium temperature can be fundamentally shifted by an external magnetic field. This shifting can be strictly calculated from easily measurable magnitudes like the susceptibility jump and the entropy jump at a phase transformation. The direct measurement of the shift evades observation by its smallness in most cases. J. J. S.

See also Abstract 290.

MAGNETISM AND ELECTROMAGNETISM.

374. Magnetic Permeability as a Specific and Relative Quantity. W. Krug. *Arch. f. Elektrot.* 30. *pp.* 752–753, *Nov.* 21, 1936.—In the equation $B = \mu H$, the induction B is measured in gauss and the field

strength H in oersteds, whilst the permeability μ is considered a pure number. Thus the left- and right-hand sides of the equation are unequal. To overcome this difficulty, a specific permeability ($= \mu_s$) is defined by means of the equation $B = \mu_s H$, so that $\mu = B/B_{air} = \mu_s/\mu_{air}$ (which is a pure number). H. J. H. S.

375. Structure and Magnetic Properties of Manganese Boride. R. Hocart and M. Fallot. *Comptes Rendus*, 203. *pp.* 1062–1064, *Nov.* 23, 1936.—MnB is orthorhombic with *a* 2·95, *b* 11·5, *c* 4·10 Å, 8 molecules in unit cell, space group (probably) D_{2h}^{16} — (P*nna*). The Mn atoms are at the summit of tetrahedra forming a layer parallel to (010), each edge and summit being common to two tetrahedra. The shortest distance Mn–Mn is 2·3 Å, with other atoms of Mn forming a chain 2·95 Å apart; Mn–B (shortest) is 2·1 Å. The magnetic properties depend greatly on the purity, the Curie point of one sample was 312 ± 10°, that of another and purer one 299 ± 4° with lower magnetic hardness. The specific magnetisation is 138·0 c.g.s. at 21°, 161·3 at −183°, whence absolute saturation is calculated as 164·5. A field of 20,000 gauss produces only 88 % saturation. The moment of the atom of Mn in the boride is 9·65 5% Weiss magnetons. These facts support Néel's hypothesis [see Abstract 1874 (1936)], the distance 2·95 Å lying between the limits 2·7 and 3·0 Å. [See Abstract 3224 (1933).] C. A. S.

376. Magnetic Susceptibility and Phase Diagram of Pd-Mn Alloys. G. Grube and O. Winkler. *Zeits. f. Elektrochem.* 42. *pp.* 815–830, *Nov.*, 1936.—An examination of the effect of temperature and concentration on the magnetic susceptibility of alloys of the Pd-Mn system and its relation to the phase diagram are described. Thermal reactions are observed on the heating curve of pure vacuum-distilled Mn at 736, 1062 and 1152° C. and on the cooling curve at 1162, 1072 and 677° C. The temperature-magnetisation curves give values of 750, 1075 and 1120° C. on heating and 1120, 1075 and 610° C. on cooling. The results of M. Gayler have shown that 3 thermal effects are to be expected, although he assumed that only two of them are due to structural changes, *viz.*, $\alpha \rightleftarrows \beta$ at 742° C. and $\beta \rightleftarrows \gamma$ at 1191° C. It is shown from the thermomagnetic results that Mn exists in 4 modifications above room-temperature; α-Mn below 740° C., β-Mn from 740 to 1070° C., γ-Mn from *c.* 1070 to *c.* 1160° C. and δ-Mn above *c.* 1160° C. The γ-phase forms a cubic face-centred solid solution in the Pd-Mn system, which suggests that the γ-phase has a cubic face-centred lattice. The Pd-Mn system is investigated by means of thermal analysis, microscopic examination and temperature-resistance curves. Also a new magnetic method is described whereby susceptibility-temperature curves of para- and diamagnetic alloys up to 1400° C. may be determined *in vacuo* or in an inert gas. The results obtained by these methods are of value in elucidating the constitution diagram of the system, which is described and discussed in detail. [See also Abstract 899 (1935).] H. J. H. S.

377. Ferromagnetic Anisotropy in Single Crystals and in Polycrystalline Sheets. R. M. Bozorth. *Phys. Rev.* 50. *pp.* 1076–1081, *Dec.* 1, 1936.—Following the work of Akulov and of Heisenberg on the magnetic anisotropy of cubic crystals, it is shown that by taking account of an additional term in the expression for the energy of magnetisation the [110] direction may under certain conditions be the direction for easiest magnetisation in a crystal, instead of [100] or [111] as given by previous theory. This is in accord with experiment. Magnetisation

curves for single crystals are calculated using the additional term and some peculiarities are recorded. The anisotropy constant appropriate for a single crystal (of Fe) has been calculated from measurements on hard-rolled sheet in which there is preferred orientation of the crystals. AUTHOR.

378. Diamagnetism of Metallic Halides. K. C. Subramaniam. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 404–413, *Oct.*, 1936.—The diamagnetic susceptibilities of a few halides of Zn, Cd and Hg are studied in the solid state and in solutions of water and methyl alcohol. Solutions of $HgCl_2$ in methyl alcohol do not show any departure from the additive law while in all the other cases, an increase in susceptibility is obtained in solutions. The increase is largest in the case of iodides and least in the case of chlorides. The order of change is the same in water and methyl alcohol. The results find an explanation from the conclusions of Fajans relating to inter-ionic deformations. The increase in susceptibility in solution is attributed to the release of deformation of the ions of the molecule by the action of the solvent to the extent of ionisation. These considerations find support from the data on electrical conductivity and the Raman effect. AUTHOR.

379. Magnetic Anisotropy of Rhombic Sulphur. P. Nilakantan. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 419–422, *Oct.*, 1936.—The magnetic anisotropy of rhombic S is determined. The magne-crystallic data are in general agreement with the results of X-ray analysis and support the idea of a puckered ring-shaped molecule consisting of 8 atoms, orientated with the plane parallel to the *c*-axis of the crystal. The magnetic data, however, give the inclination of the plane of the ring to the *a*-axis to be about 70° instead of 50° as suggested by X-ray analysis. AUTHOR.

380. Paramagnetic Relaxation in Transversal Magnetic Field. C. J. Gorter. *K. Onnes Lab., Leiden, Comm. No.* 247*b*. *Physica*, 3. *pp.* 1006–1008, *Nov.*, 1936. *In English.*—The heat liberated in a paramagnetic substance by a h.f. alternating magnetic field decreases when a constant transverse magnetic field is applied. In V alum and diluted Cr alum, the heat liberation is reduced to zero by a cross field of 10^2 oerstedt, and in Fe alum by 10^3 oerstedt. The material was the same as in a previous research. [See Abstract 3890 (1936)]. G. E. A.

381. Magnetic Moment of Ions. G. Foex and C. Fehrenbach. *Comptes Rendus*, 203. *pp.* 857–860, *Nov.* 3, 1936.—Measurements of the magnetisation of anhydrous $CoCl_2$ are graphed, giving $1/\chi T$ as a function of the reciprocal of the temperature. When the temperature diminishes quickly from 600° K., the points lie on two consecutive straight lines at a small angle to each other ; when there is a slow fall of temperature, they lie on a curve close to the two lines, and for the higher values of $1/\chi T$, the curve coincides with one of the lines. There is, hence, a change from a moment 25·67 to a moment 24·70 which is progressive in one case and sudden in the other. The curve indicates, not a superposed diamagnetism, but a variation of the moment with the temperature. For compounds which follow Cabrera's law the calculation of the moment therefore remains problematic. G. E. A.

382. Theory of Magnetism of Biradicals. E. Hückel. *Zeits. f. phys. Chem.* 34. *Abt.B.* 5. *pp.* 339–347, 1936.—A quantum theoretical interpretation is given for the diamagnetism shown by triphenyl methyl, when the two benzene rings are joined in the para positions, and for the paramagnetism of the compound when the union of the two benzene rings is in the meta position. A diamagnetic state must exist for the meta compound, which is closely allied energetically to the paramagnetic state.

The distinguishable magnetic behaviour is considered to be due to the molecular electron condition. F. J. B.

383. Interactions of Electromagnetic Fields. B. Podolsky. *Phil. Mag.* 22. *pp.* 998–1002, *Nov.*, 1936. *Supplement.*—Japolsky's theory of forces between wave packets is criticised on the ground that since the Maxwell-Lorentz equations are linear any two solutions corresponding to two wave packets are additive and hence the wave packets are propagated independently. The manner in which Japolsky's calculation breaks down is indicated. **N. S. Japolsky,** *ibid. pp.* 1003–1004, gives reasons for rejecting these criticisms. W. S. S.

384. Foundations of Electrodynamics. T. Schlomka. *Zeits. f. techn. Physik*, 17. 11. *pp.* 459–463, 1936.—The author asserts that Maxwell's theory of the electromagnetic field ought to be based on the assumption of the existence of the retarded scalar and vector potentials and not, as is usually done, on the existence of the electric and magnetic forces. G. C. McV.

***385. Lloyd-Fisher Square for Permeability Measurements. C. E. Webb and L. H. Ford.** *Journ. Sci. Instruments*, 13. *pp.* 386–392, *Dec.*, 1936.—An examination is made of the errors involved in the measurement of normal and incremental permeability on strips assembled in the Lloyd-Fisher square, as used for total loss testing. It is shown that in normal permeability measurements, in the range from B = 10,000 to 15,000 gauss, the results obtained by treating the assembled square as a ring give only a lower limiting value for the permeability. In incremental permeability measurements with flux density variations, ΔB, less than 1000 gauss, on the other hand, the errors are smaller and in many cases are not serious in view of the variability of the properties of the material and the large time effects occurring in that range of flux density. AUTHORS.

***386. Design of Powerful Electromagnets. Parts I and II. F. Bitter.** *Rev. Sci. Instruments*, 7. *pp.* 479–488, *Dec.*, 1936.—In Part I it is shown that the iron in the usual Weiss type of electromagnet is not as efficiently used as it might be whenever as intense fields as possible are desired. A design is proposed, consisting essentially of a small magnetising coil completely surrounded by iron except for openings to the centre of the coil where the magnetic field is produced. In Part II the characteristics of such a magnetising coil are discussed, and it is shown that the important factors are the shape of the coil, the power available, the distribution of current density and the efficiency of cooling. Formulæ applicable to coils of various types are derived, and the main features of an efficient design are determined. AUTHOR.

***387. Pendulum Magnetometer for Crystal Ferromagnetism. L. W. McKeehan, R. G. Piety and J. D. Kleis.** *Rev. Sci. Instruments*, 7. *pp.* 494–497, *Dec.*, 1936.—Improvements in the method of preparing spheroidal specimens, in the suspension of the pendulum, in the method of measuring its displacement, and in correcting for the field gradient due to the magnetising solenoid are reported. New means for protecting small specimens from atmospheric action without rigid constraint and up to the softening temperatures of Pyrex glass (or of fused silica) are described. [See also Abstract 3938 (1934).] AUTHORS.

***388. Coercimeter for Magnetically Weak Materials. E. V. Potter and E. F. Coleman.** *Rev. Sci. Instruments*, 7. *pp.* 499–501, *Dec.*, 1936.—A form of coercimeter based on that of Davis and Hartenheim

[see Abstract 1869 (1936)] is described. By altering constructional features and using a direct-coupled thermionic amplifier and microammeter for indicating balance, the accuracy and sensitivity of measurements on the coercive force of magnetically weak materials like slags are improved. A stable 2-stage amplifier makes the balance indication more sensitive by a factor of about 200. The range of application of the instrument is thus also extended to alloys of very low coercive force and to cases where the available sample is very small. AUTHORS.

See also Abstracts 86, 226, 351.

MEDICAL RADIOLOGY AND ELECTROLOGY.

389. Electromedical Practice. Use of L.T. Currents. H. H. U. Cross. *Electrician*, 117. *pp.* 487–489, *Oct.* 23, 1936.—Summary of recent advances in electromedicine, with special reference to chromaxy, which is claimed to be a valuable adjunct to the diagnosis of muscular complaints. G. E. B.

390. Behaviour of Colloidal Systems in U.H.F. Electromagnetic Fields. B. Rajewsky and H. Schaefer. *Kolloid Zeits.* 77. *pp.* 257–259; *Disc.*, 260, *Nov.*, 1936.—This investigation deals with electromagnetic waves up to 1 m. wave-length and their influence on colloidal systems in which the disperse phase is surrounded by a sheath or membrane of a third substance, *e.g.*, with latex, blood, etc. Such a system possesses a characteristic course of the conductivity with the wave-length; in the region of the longer waves the conductivity is practically constant, but increases with decreasing wave-length and for very short waves is again independent of frequency. The characteristic region of transition is termed the dispersion zone, and its position depends on the structure and dimensional relationships of the particles. Experimental details are included and the work of previous investigators is correlated [see Abstract 338 (1936)]. Dänzer's [see Abstract 1270 (1935)] application of the Debye dipole theory to his data is discussed, and it is shown that (1) the theory as now developed enables an exact survey to be made of the energy distribution during the application of h.f. fields to known systems; (2) the possibility of selective effects for definite wave-lengths may be examined; and (3) that the dispersion curve of a colloidal system may afford information with respect to particle size, and the dimensions of the separate phases of the system. Applications are made to biological problems. H. H. Ho.

***391. X-Ray Kinematography. R. Janker.** *Am. J. of Roentgenology and Radium Therapy*, 36. *pp.* 384–390, *Sept.*, 1936.—A description is given of the apparatus, fluorescent screens and photographic films employed by the author in his development of practical X-ray kinematographic procedures, particularly in respect to physiological and pathological investigations. The direct method, *i.e.*, direct recording upon the photographic film, has been used as well as the indirect method, in which kinematographic film is taken of a fluorescent screen image, the advantage of the latter method being the use of smaller film sizes. Films of the human stomach, thorax, etc., have been obtained. Further the human body has been photographed in its entirety upon a single film. B. J. L.

*** 392. Intensifying Screens and the Potter-Bucky Diaphragm in Radiography. O. M. Alexander.** *Radiography*, 2. *pp.* 163–171, *Nov.*, 1936.—Remarks on the construction and functions of intensifying screens and the Potter-Bucky diaphragm.

393. Positive Film Transparencies. J. J. Murphy. *Radiography*, 2. *pp.* 173–174, *Nov.*, 1936.—Since the introduction of duplitised X-ray film the desire generally is no longer to view a simple photographic image, but rather to view an image through a viewing box as with radiographs. The use of X-ray film to produce such transparencies (not in respect to radiographs) is discussed in detail as regards illumination, development, enlargement, etc. B. J. L.

***394. Effective Method for Using Lead or Other Low-Melting Metals for X-Ray Targets. T. R. Folsom.** *Rev. Sci. Instruments*, 7. *pp.* 406–408, *Nov.*, 1936.—Experiments were conducted to develop a more economical and satisfactory target for a 650-kV X-ray machine. It was found that lead, electroplated on to a thin, stretched disc of Cu cooled with water would withstand up to 2 mA/cm^2. electron bombardment continuously at 650 kV. This technique seems applicable for experimental tubes where lead or other low melting metal is desired for a target material. AUTHOR.

***395. Nomogram for the Determination of Half-Value Layers. W. Binks.** *Brit. J. of Radiology*, 9. *pp.* 743–749, *Nov.*, 1936.—Although a statement of the half-value layer does not specify the X-ray quality of the radiation in the sense of the accepted definition, it is often sufficient to characterise the radiation. An analysis of the results of several workers shows that a statement of exciting voltage, filtration and type of generator (constant—or pulsating—potential) is sufficient to specify "quality" as expressed by the half-value layer in Cu. The relationship between voltage, filtration and the mean H.V.L.s for each type of generator is conveniently represented in the form of a nomogram. AUTHOR.

396. Protection Problems Associated with 5-gm. Radium Unit. L. G. Grimmett and J. Read. *Brit. J. of Radiology*, 9. *pp.* 712–731, *Nov.*, 1936.—The radiation field of the 5-gm. Ra unit of the Radium Beam Therapy Research, London, has been measured throughout the building, and shown to be less than 10^{-5} r/sec. everywhere except for a few places in the immediate vicinity of the treatment room. Some measurements of γ-ray absorption in masonry are given; it is shown that γ-ray transmission through brickwork may be simply computed by assuming a mass absorption coefficient 0·03 gm.$^{-1}$, which slightly over-estimates the radiation danger. The method of measuring the exposure of the staff handling the Ra is described. Analysis of the results shows that it is easy to keep within the prescribed limit of 0·03 r per day. Finally, the significance of the "tolerance intensity" is reviewed in the light of recent knowledge. AUTHORS.

397. Release of Ultra-Violet Radiation from Roentgenised Substances by Visible Light. O. Glasser and I. E. Beasley. *Am. J. of Roentgenology and Radium Therapy*, 36. *pp.* 381–382; *Disc.*, 383, *Sept.*, 1936.—Visible fluorescence under the influence of X-rays and γ-rays has been known and studied for a long period. In 1923 Perrine demonstrated it in the u.v. region. In 1934 Kudrjaezewa investigated u.v. fluorescence from rock-salt crystals emitted under the influence of visible light, after prior X-ray irradiation. The present authors have pursued these investigations in respect to 35 various salts. U.v. phosphorescence persists for long periods after X-ray and γ-ray irradiation and is conspicuously increased if the irradiated compounds are subjected to visible light. Decay curves were obtained and the half life of the induced u.v. phosphorescence ranges from a few minutes to several months, depending

upon the type of salt, its purity and the intensity and duration of the primary radiation. Possible significance of this phenomenon in respect to radiation therapy is mentioned and in the *Discussion* **L. S. Taylor** quoted a case of his experience, where a radiation burn possibly arose from the action of fluorescence after X-ray irradiation and subsequent exposure to h.f. oscillation. B. L.

OSCILLATIONS.

398. Short-Wave Propagation Round the Earth. O. v. Schmidt. *Zeits. f. techn. Physik*, 17. 11. *pp.* 443–446, 1936.—The difficulties of earlier theories are discussed, and then the idea is introduced that a " wandering reflection " at the F-ionosphere layer causes a short wave to run along this layer with velocity $c = 3 \times 10^5$ km./sec., continually sending radiation down to the earth at the angle of total reflection. This is in agreement with the time of propagation of the wave and its transmission over long distances over the earth. H. M. B.

399. Audibility of a Limit Wave (10 m.) and Solar Phenomena. K. Stoye and E. Fendler. *E.N.T.* 13. *pp.* 397–400, *Nov.*, 1936.—Corresponding to the rapid increase of the sun's activity during the year 1935 the reliability of communication on waves in the region of wavelengths 10·0 to 10·7 m. was also found to vary. Discussion of the results of observations of European and oversea stations extending over many months show that in years when communication on these wave-lengths is generally confined to relatively short ranges (sunspot minimum) the days with good reception are those showing slight magnetic disturbances, while in years when oversea communication is possible (sunspot maximum) the days with good long distance reception are those with high magnetic character number, though this is not the case for communication over shorter distances. [See also Abstract 1892 (1936).] A. W.

See also Abstracts 146, 328, 329, 390.

PHOTOELECTRICITY.

400. Theory of Photoelectric Absorption for X-Rays and γ-Rays. H. Hall. *Rev. Modern Physics*, 8. *pp.* 358–397, *Oct.*, 1936.—Report on methods and results for the photoelectric absorption coefficient of atoms and for the angular distribution of photoelectrons. The problem is treated in non-relativistic and in relativistic approximation. R. P.

401. Influence of Light and Heavy Hydrogen on Selective Photoelectric Effect in Alkali Metals. W. Kluge and W. Uhlmann. *Zeits. f. techn. Physik*, 17. 11. *pp.* 431–436, 1936. *Phys. Zeits.* 37. *pp.* 857–862, *Dec.* 1, 1936.—In photoelectric cells of the hydrided alkali type the effect of the substitution of deuterium for the hydrogen was investigated. It was found that in Li the spectral sensitivity curve was shifted towards the violet by 7–12 mμ, in Na it is shifted by 1–2 mμ, and in K there is no shift. The shift is associated with the reduced lattice constant of the alkali deuteride compared with the hydride. This provides qualitative support for the Olpin modification of the theory of Campbell and Fowler of the selective photoelectric effect in this type of kathode. The authors suggest a tentative modification of the theory. D. H. F.

See also Abstracts 210, 368.

PIEZOELECTRICITY.

402. Optical Diffraction Effects with Oscillating Crystals in Reflected Light. C. Schaefer, L. Bergmann and H. Ludloff. *Preuss. Akad. Wiss. Berlin, Ber.* 20. *pp.* 245–256, 1936.—In the first part of this

paper Schaefer and Bergmann present the results of further investigations of diffraction effects at the surface of oscillating crystals. For these investigations the light was reflected from one of the crystal faces, the crystal being of quartz. It is shown that under these conditions the diffraction pattern obtained is either a circle or an ellipse with the major axis inclined to the horizontal at about 18°. In the second part of the paper Ludloff gives a theoretical explanation of the experimental results. [See also Abstract 3695 (1935).] A. W.

See also Abstracts 173, 342.

THERMIONICS.

403. Dependence of the Emission of Field Electrons on the Work Function. E. W. Müller. *Zeits. f. Physik*, 102. 11–12. *pp.* 734–761, 1936.—Ba, Mg or Ca are deposited on a pure W point by condensation, and the work function ϕ is found for different thicknesses of the element. Immediately after the thermionic emission, cold electron emission in an electric field is measured. According to wave mechanics, the log. of the current density of the field emission should be proportional to $\phi^{3/2}$, but by measurement ϕ^3 seems more nearly correct, and is independent of the thickness of the deposit. The failure of a cooling effect and the velocity distribution of the electrons show that the increase of potential corresponding with the work function is not exceeded. H. M. B.

404. Electron Emission under the Action of Intense Fields. E. W. Müller. *Zeits. f. techn. Physik*, 17. 11. *pp.* 412–416, 1936. *Phys. Zeits.* 37. *pp.* 838–842, *Dec.* 1, 1936.—A W kathode, ending in a fine point, was heated to 1100° K. and an autoelectronic emission of 5 mA was produced. No measurable cooling of the kathode was observed. The energy distribution of the electrons is given. It shows, in agreement with current views, that the electrons are not decelerated by the work function of the kathode. Allowance, however, must be made for the work function of the cage on which the electrons are observed. The autoelectronic emission was also measured for W kathodes covered by Ba layers of varying thickness and the emission constant is found to be proportional to the cube of the work function. The theoretical significance of this fact is discussed. R. P.

See also Abstracts 288, 289.

THERMOELECTRICITY.

405. Resistometric Method for Determination of the Electrothermic Homogeneous Effect and Gas Ion Effect. C. Benedicks, C. W. Borgmann and P. Sederholm. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*A*. *No.* 9. [28 *pp.*], 1936. *In English.*—A resistometric method based on the use of a Wheatstone bridge has been introduced for the determination of the electrothermic homogeneous effect in metal wires. It is found that Cu gives regular results of correct sign at a temperature of about 26° C. and that the electrothermic homogeneous effect depends slightly on the gas pressure. In Pt certain irregularities are observed depending on the pressure of gas surrounding the test wire. The authors point out that two different effects are present: (*a*) a negative effect, the so-called "metal effect" or electrothermic homogeneous effect of gas-free Pt, and (*b*) a positive effect the so-called "gas-effect" or electrothermic effect of the gas ions. R. L.